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AUTHOR Gibson, J. C.; And Others

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ABSTRACT

Designed for use when the student or the class is expected to grow a crop using the high school greenhouse, these learning activity packages are sequenced in typical greenhouse cropping fashion: (1) poinsettias in the fall, (2) Easter lilies (bulb crop) in the winter, (3) bedding plants (seed crop) in the spring, and (4) a nursery crop (from cuttings) in the summer. Included within each of these four areas are activities such as selecting crops, propagation, preparing soil mixtures, and transplanting. Each of the twenty-five learning activity packages is divided into the following parts: introduction, directions, objective, learning activities, tools and equipment, materials and supplies, safety, instructions, student self-check with correct responses, and a final check-out activity. In addition, an instructor's final checklist is included with each package. (LRA)

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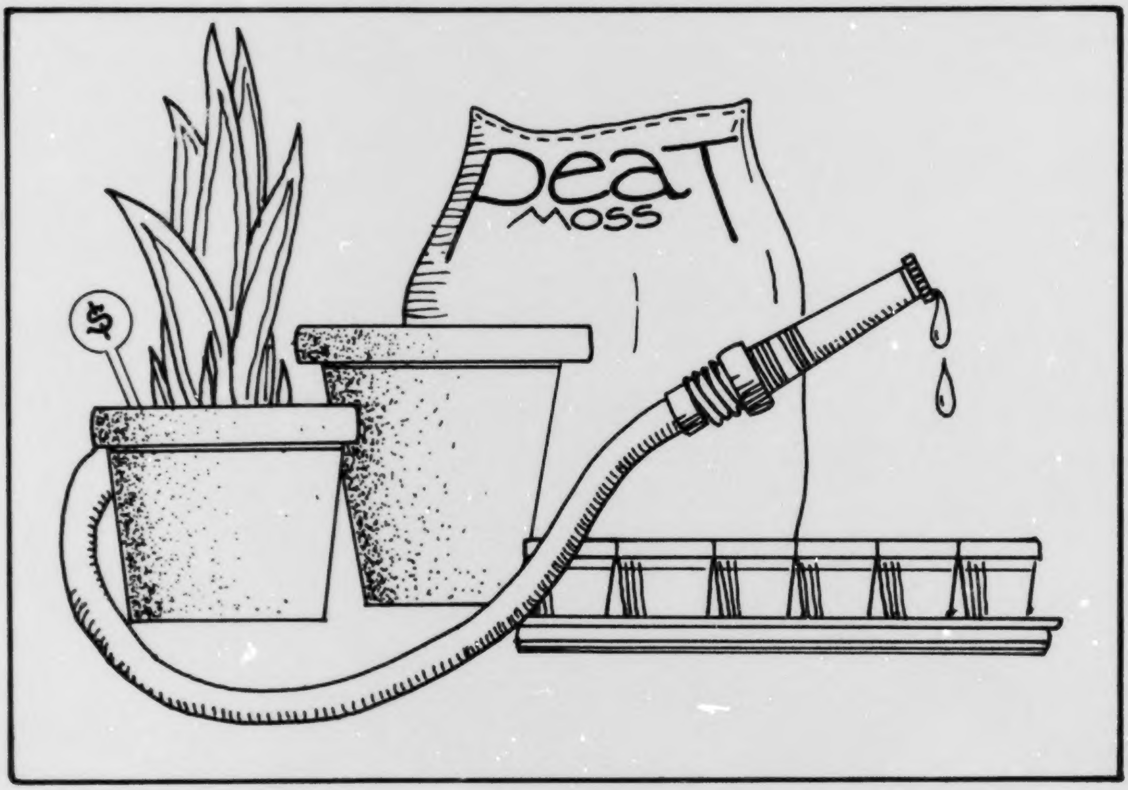
GREENHOUSE PRODUCTION

A Series of
Learning Activity Packages



State Department of Education
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In Cooperation With

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Clemson University
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INTRODUCTORY STATEMENT

These Learning Activity Packages were designed for use when the student or the class is expected to grow a crop using the high school greenhouse. They can be used in conjunction with the more task specific learning activity packages developed directly from the V-TECS catalogs or can be used following the completion of such packages. These learning activity packages are broader in scope and are usually crop specific, e.g., "Propagating Poinsettias" and are meant to exemplify a typical commercial greenhouse sequence, i.e., poinsettias in the fall, followed by Easter lilies in the winter, bedding plants in the spring and nursery crops in the summer. This particular sequence was also chosen for the diversity offered in methods of propagation, i.e., poinsettias from softwood cutting, Easter lilies from bulbs, bedding plants from seeds, and nursery crops from various types of cuttings. The sequence also provides a variety of production practices, and finally the sequences provide a functional means of integrating the more job specific learning activity packages developed from the V-TECS floriculture catalog of performance objectives.

The learning activity packages are sequenced in typical greenhouse cropping fashion: (1) Poinsettias in the fall, (2) Easter lilies (bulb crop) in the winter, (3) bedding plants (seed crop) in the spring, and (4) a nursery crop (from cutting) in the summer. Although these packages contain some instructional content, they were not meant to be content complete. The references recommended are in most cases necessary. If the publication recommended is not available, however, the instructor can in most cases find an adequate substitute. When a substitute publication is used, the instructor should write it in under LEARNING ACTIVITIES and delete the publication recommended. For a summary of recommended publications, see RECOMMENDED STUDENT REFERENCES at the back of this publication.

ACKNOWLEDGEMENTS

Grateful appreciation is extended to the following persons who contributed to the development of these learning activity packages:

The writers were:

Mr. J. C. Gibson – Fall Sequence
Former Teacher of Agriculture now with the State Department of Education

Mr. W. J. Wilson – Winter Sequence
Teacher of Agriculture, Aiken High School

Mr. R. C. Chastain – Spring Sequence
Teacher of Agriculture, Greer High School

Mr. R. P. Smoak – Summer Sequence
Teacher of Agriculture, Rock Hill, Career Development Center (Retired)

Mr. Hugh P. McClimon, District Consultant of Agricultural Education, coordinated the development of these learning activities.

Illustrations were prepared by R. D. Mattox, Art Director, Vocational Education Media Center, Clemson, South Carolina. Editing was by Mrs. Joyce Farr and typing by Kathy Murdoch of the Vocational Education Media Center.

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The final copy was edited by Dr. R. J. Mercer, Vocational Instructional Materials Specialist, Vocational Education Media Center, Clemson, South Carolina.

GREENHOUSE PRODUCTION

Learning Activity Packages

Number

Fall Sequence

Selecting a Fall Greenhouse Crop 1
Propagating Poinsettias 2
Selecting and Preparing a Soil Mixture for Poinsettias 3
Transplanting Poinsettia Cuttings 4
Growing Poinsettias 5

Winter Sequence

Selecting a Winter Greenhouse Crop 6
Preparing a Soil Mixture for a Typical Winter Greenhouse Crop 7
Potting a Bulb Crop 8
Fertilizing Bulb Crops 9
Forcing Easter Lilies 10

Spring Sequence

Selecting Bedding Plant Crops and Varieties 11
Selecting and Preparing a Germination Media 12
Selecting Bedding Plants 13
Germinating Bedding Plant Seeds 14
Transplanting Bedding Plants 15
Growing-Out Bedding Plants 16

Summer Sequence

Selecting Crops to be Propagated and Grown 17
Selecting Methods of Propagating a Nursery Crop 18
Determining the Quantity of Plants to Propagate 19
Preparing a Schedule for Producing Ornamental Nursery Plants from Cuttings 20
Selecting and Preparing a Medium for Propagating Cuttings 21
Sterlizing Soil 22
Selecting Cutting Material 23
Taking Cuttings 24
Rooting Cuttings 25

Learning Activity Package No. 1

GREENHOUSE
PRODUCTION

FALL SEQUENCE

SELECTING A FALL
GREENHOUSE CROP

Ornamental Horticulture

INTRODUCTION

One of the first and most important decisions to be made by a greenhouse grower is that of selecting the crop or crops to be grown. There are, of course, many factors to be considered in making such a decision. You should be aware of some of these factors.

Sad to say, but good estimates on production costs are hard to find. Most growers probably make this very critical decision based on experience or based on the advice of others who have had experience.

In this learning activity package, you will learn some guidelines for selecting a fall greenhouse crop.

DIRECTIONS

Read the objectives below. If you think that you are already able to perform these tasks, read the Check-Out Activities on the next to the last page of this module. Then either arrange with your instructor about doing the Check-Out Activities,

or

If you need further preparation in order to do the tasks, go through the Learning Activities.

OBJECTIVE

Compare and contrast flowering pot plants in terms of profitability for production in the local area.

LEARNING ACTIVITIES

1 READ the following:

Greenhouse Flower and Bedding Plants for Agribusiness Studies, Williams, G. S., pp. 15-41.

2 READ the Instructions, Selecting a Fall Greenhouse Crop.

3 INTERVIEW see suggested interview guide.

4 CHECK YOUR KNOWLEDGE by using the Student Self-Check.

5 ARRANGE with your instructor to complete this learning activity package by going through the Check-Out Activity.

TOOLS AND EQUIPMENT

None needed

SUPPLIES AND MATERIALS

None needed

SAFETY

Not applicable

INSTRUCTIONS

SELECTING A FALL GREENHOUSE CROP

1. Can the crop be grown and sold in time to allow space for the winter greenhouse crop?

   Many greenhouse crops can be started in late summer or early fall and be ready for the market by Christmas. Most fall crops are grown especially for Christmas market. Poinsettias are especially popular; chrysanthemums, carnations and begonias are also grown for the Christmas market. But, regardless of the crop selected, it should be marketed by January 1 to allow adequate bench time for the winter crop.

Figure 1. The poinsettia – the most popular Christmas pot plant

2. Can the crop be marketed at a price sufficient to cover cost and still provide a reasonable profit margin?

   "Ah, there's the rub" – can I make a profit with this crop? Good cost records are difficult to find, so you may have to rely on rough estimates. Perhaps a table such as the one shown on the following page could be constructed with the help of local growers.

3. Do you have adequate facilities for growing the crops under consideration?

   Facilities for growing fall sequence greenhouse crops (usually poinsettias, chrysanthemums or begonias) are roughly comparable and about the same amount of space is required.

4. Do you have sufficient labor for growing the crops under consideration?

   Labor requirements vary considerably in the production of these crops. Poinsettias require much labor and expert management.

5. Do you have the knowledge or experience necessary to grow the crops under consideration?

   Some crops are complicated to grow. For example, growers sometimes say "you'd better know what you're doing when you grow a crop of poinsettias." Poinsettias are relatively complex to grow as compared to geraniums or begonias.

6. Where can I obtain advice about selecting a fall greenhouse crop?

   Several sources of help are available for selecting a crop, some of these are as follows:

   a. local growers
   b. local teachers of agriculture
   c. local agricultural extension agent
   d. references stated on page 1

SUGGESTED INTERVIEW GUIDE

Questions to ask local greenhouse growers:

1. Which flowering pot plants have you found to be most profitable to grow in the fall greenhouse sequence?

2. What is your best estimate as to the cost of producing flowering plants you grow?

CHART I

ESTIMATED REVENUE, EXPENSES AND PROFITS

	POINSETTIAS		CHRYSANTHEMUMS	
	Debit	Credit	Debit	Credit
Revenue				
Sales				
Expenses				
Overhead				
Labor				
Supplies				
Total Expenses				
Net Income				

3. Which crops do you think have the greatest potential? Why?

4. Which of the crops you grow are most "cantankerous"? Which require the most expertise?

5. Do any of the crops you grow have special facility or equipment requirements?

6. If you were a beginning grower, what flowering pot plants would you recommend?

7. Which of the flowering pot plants requires the largest amount of labor? Capital?

STUDENT SELF-CHECK
DO NOT WRITE ON THIS SHEET
SELECTING A FALL GREENHOUSE CROP

1. List four flowering pot plants commonly grown in the fall greenhouse sequence.

2. List at least five factors to consider in selecting a flowering pot crop to be grown in the fall sequence.

3. List at least three sources of information helpful in selecting a flowering pot plant to be grown in the fall sequence.

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next learning activity.

CORRECT RESPONSES

1. Poinsettia, Chrysanthemums, Carnations, and Begonias

2. a. Is there enough time to grow the crops in the fall?
   b. Is there demand for the crop?
   c. Can the crop be sold for a profit?
   d. Is the greenhouse equipped with the necessary facilities?
   e. How hard is the crop to grow?

3. a. Local growers
   b. Local teachers of agriculture or agricultural extension agents
   c. Reference listed for this package on page 1

CHECK-OUT ACTIVITY

In order to finish this learning activity package you must be able to complete the task(s) listed below. As you go through each activity, your instructor will rate your performance using the Instructor's Final Checklist, *SELECTING A FALL GREENHOUSE CROP.*

Select a fall greenhouse crop.

DO NOT WRITE ON THIS SHEET

LAP 1

Student ______________________

Date ______________________

SELECTING A FALL GREENHOUSE CROP

Instructor's Final Checklist

Check the student's performance in the following elements of selecting a fall greenhouse crop.

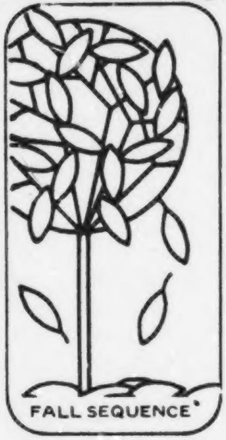
Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. Crop or crops selected fit(s) into the growing schedule	☐	☐	☐	☐
2. Crop or crops selected are among those with the better profit potential	☐	☐	☐	☐
3. Demand for the crop or crops selected is relatively high	☐	☐	☐	☐
4. Student can compare crop or crops as to difficulty of production.	☐	☐	☐	☐

Learning Activity Package No. 2

GREENHOUSE PRODUCTION



PROPAGATING POINSETTIAS

Ornamental Horticulture

INTRODUCTION

The propagation of poinsettias is an important phase of the production process. Timing is critical because it is at propagation that the "count down" to Christmas begins. Cuttings must be carefully selected, the rooting media carefully prepared, and moisture and temperature carefully controlled. In this package you will learn to propagate poinsettias.

DIRECTIONS

Read the objective below. If you think that you are already able to perform these tasks, read the Check-Out Activities. Then either arrange with your instructor about doing the Check-Out Activities,

or

If you need further preparation in order to do the tasks, go through the Learning Activities.

OBJECTIVE

Propagate poinsettias in a manner approved by the industry.

LEARNING ACTIVITIES

1 READ the following: *The Ball Red Book*, George J. Ball, Inc., pp. 408-411.

2 READ the Instructions *A – Propagating Poinsettias.*

3 READ the Instructions *B – Taking Poinsettia Cuttings.*

4 CHECK YOUR KNOWLEDGE by taking the Student Self-Check.

5 OBSERVE another student as he or she makes and "sticks" cuttings.

6 PRACTICE taking and "sticking" poinsettia cuttings.

7 ARRANGE with your instructor to complete this learning activity package by going through the Check-Out Activity.

TOOLS AND EQUIPMENT

1. Sharp knife
2. Sterile containers
3. Bucket partially filled with water

MATERIALS AND SUPPLIES

Stock Plants

SAFETY

Take care when using sharp knives.

INSTRUCTIONS

A – PROPAGATING POINSETTIAS

1. Should I purchase rooted cuttings (liners) or should I order stock plants?

   The grower must decide how to start the production process. He or she must decide if liners are to be purchased from specialist propagators or if stock plants from which cuttings are taken will be grown locally or from stock plants purchased from commercial companies. Stock plants are plants which are used for cuttings. It should be pointed out that many poinsettia varieties are patented and cannot be used for further propagating. When purchasing liners of patented varieties, the grower must sign an agreement that states that there will be no further asexual propagation of these liners. Liners may be purchased from reputable wholesalers. If stock plants are to be used for local asexual reproduction, it is important that the cuttings be made properly, that proper media is used for rooting and that proper environmental conditions be provided. Many growers prefer to order liners because of the extra labor and time involved in rooting cuttings. Most schools will want to use stock plants so that students experience the entire propagation process.

2. When should poinsettia cuttings be taken?

   Poinsettias are grown almost exclusively for the Christmas market. Cuttings taken in late summer and early fall will develop to a desirable size by Christmas. The earlier the cutting is rooted, of course, the larger the plant will be at Christmas.

   Since it may be difficult or inefficient to start all cuttings at one time it is common practice to take cuttings at intervals. Cuttings taken in July are usually pinched. Pinching is removing about one inch of growth from a stem. This causes branching and the subsequent formation of two or three flower heads instead of the one which would normally be formed.

   Cuttings started in August will usually become very large if not pinched. Sometimes these plants are allowed to grow very large and are therefore used for church or store decorations.

   Cuttings started in September are usually of the size and height most in demand.

   Usual cutting schedule:

   JULY – For plants to be pinched.

   AUGUST – For large plants to be used in churches or stores.

   SEPTEMBER – For plants of a size most in demand.

3. What types of media are suitable for propagating poinsettia?

   Sand, perlite or vermiculite make good media for rooting poinsettias. The media should be sterilized. If you are not familiar with sterilization procedures, see Learning Activity Package 22. Fill the bench with at least six inches of one of these materials.
   Add at least 6 inches (15 cm) of sand, perlite or vermiculite.
   Make sure bench is well drained.

4. Should a rooting hormone be used?

   Rooting hormones are not necessary for root initiation, but they do speed the rooting process and provide more uniformity in rooting.

   Most hormones are powders prepared and packaged in small jars or boxes. To apply hormone, dip about ½ inch (1.27 cm) of each cutting into the powder and tap on side of container to remove excess hormone.

5. How should the cuttings be handled once they are removed from the stock plant?

   Cuttings from poinsettia plants must be handled carefully. They must be protected from drying caused from heat or wind. The leaves and stems must not be damaged because this may cause additional water loss or provide an entrance for disease organisms.

   It is important to remember that only a few cuttings should be taken at any one time. The cuttings should be placed in a suitable rooting medium as soon as possible.

6. What are the optimum environmental conditions for rooting poinsettias?

   Control of the environmental conditions is very important for successful rooting of cuttings. Temperature and humidity are two very important environmental conditions which must be controlled.

   A cutting will root in three weeks if the air temperature is maintained at 60 degrees F (16 degrees C) and the bench temperature is maintained at 70 degrees F (21 degrees C). Electric cables designed to warm the soil should be used to maintain the bench temperature at 70 degrees F (21 degrees C). If temperatures are not maintained, the cuttings will root very slowly.

   Poinsettia cuttings are best rooted under a mist system. When the mist is used, the cuttings do not have to be shaded. Without the mist, shading is necessary so the cuttings won't lose excessive moisture.

   The mist system should be set for 5 second intermittent misting at 30 minute intervals.

INSTRUCTIONS

B – TAKING POINSETTIA CUTTINGS

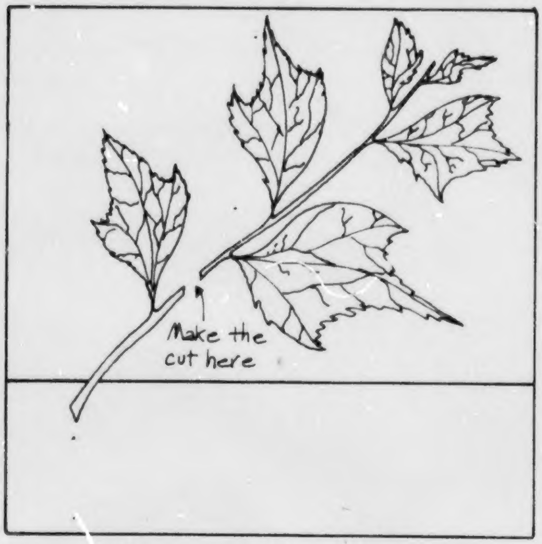


Figure 1. Make cut between the 3rd and 4th fully developed leaves.

1. Using a sharp knife, make a stem cutting between the third and fourth fully mature leaves of the stock plant.
2. Dip the stem end of each cutting into a hormone powder. (Approximately ½ inch (1 cm) of the stem should be coated with the powder.)
3. Place the cuttings 2 inches (5 cm) apart in 5 inch (13 cm) rows. Cuttings should be stuck to a depth of 2 inches (5 cm).

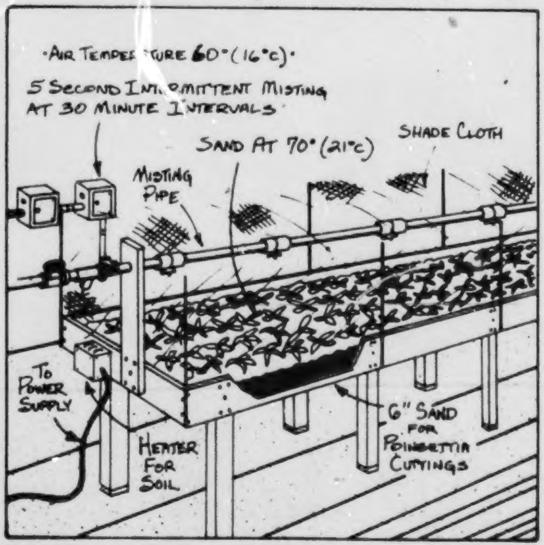

·AIR TEMPERATURE 60° (16°C)·
5 SECOND INTERMITTENT MISTING AT 30 MINUTE INTERVALS
SAND AT 70° (21°C)
SHADE CLOTH
MISTING PIPE
TO POWER SUPPLY
HEATER FOR SOIL
6" SAND FOR POINSETTIA CUTTINGS

Figure 2. Environmental conditions for rooting poinsettia cuttings.

4. Set mist system for 5 second intermittent misting at 30 minute intervals.

5. Hang a layer of muslin cloth over the cuttings to provide light shading.

6. Set soil temperature at 70 degrees F (21 degrees C). Check soil temperature and adjust as needed.

7. Check air temperature. Adjust thermostat or ventilation to keep air temperature at 60 degrees F (16 degrees C).

STUDENT SELF-CHECK
DO NOT WRITE ON THIS SHEET
PROPAGATING POINSETTIAS

Directions: Circle the letter for the correct answer.

1. Poinsettia cuttings should be taken indoors during:

   a. early August
   b. late November
   c. late August or early September
   d. late September or early October

2. A good rooting medium for poinsettias is:

   a. peat, sand and perlite or vermiculite
   b. well rotted manure
   c. sand and perlite
   d. peat and vermiculite

3. Rooting hormones are used on poinsettia cuttings to:

   a. promote root initiation
   b. speed up rooting and provide rooting uniformity
   c. sanitize the cutting
   d. prevent wilt

4. Adequate environmental conditions for rooting poinsettias are provided by:

   a. 60–68 degrees F (17 – 20 degrees C) bottom heat
   b. misting
   c. 80–85 degrees F (27 – 29 degrees C) bottom heat and misting
   d. 70 degree F (21 degree C) bottom heat and misting for 2–3 weeks after sticking

5. Poinsettia cuttings should be stuck:

   a. one day after taken
   b. immediately after taken
   c. 2 hours after taken
   d. any time that suits propagator

6. The propagating specialist makes poinsettia cuttings with:

   a. anvil type hand pruner
   b. scissors
   c. hook type hand pruner
   d. clean sharp knife

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next learning activity.

CORRECT RESPONSES

1. c
2. a
3. b
4. d
5. b
6. d

CHECK-OUT ACTIVITY

In order to finish this learning activity package you must be able to complete the task(s) listed below. As you go through each activity, your instructor will rate your performance using the Instructor's Final Checklist.

Propagate poinsettias in a manner approved by the industry.

DO NOT WRITE ON THIS SHEET

LAP 2

Student ______________________

Date ______________________

PROPAGATING POINSETTIAS

Instructor's Final Checklist

Check the student's performance in the following elements of propagating Poinsettias.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. Student used a sharp knife	☐	☐	☐	☐
2. Student made cutting between the third and fourth fully mature leaf of the stock plant.	☐	☐	☐	☐
3. Stem was dipped in hormone powder	☐	☐	☐	☐
4. Cuttings were placed about 2 inches (5 cm) in rooting media and 2 inches (5 cm) apart in 5 inch (13 cm) rows.	☐	☐	☐	☐
5. Soil temperature was kept at 70 degrees F (21 degrees C)	☐	☐	☐	☐
6. Air temperature kept at about 60 degrees F (16 degrees C)	☐	☐	☐	☐
7. Mist system was set at 5 second intermittent misting at 30 minute intervals	☐	☐	☐	☐

Learning Activity Package No. 3

GREENHOUSE PRODUCTION

FALL SEQUENCE

SELECTING AND PREPARING A SOIL MIXTURE FOR POINSETTIAS

Ornamental Horticulture

INTRODUCTION

Commercial growers invest thousands of dollars in each crop of poinsettias produced. Much of this investment may result in little return if the grower is careless in selecting the soil mixture. The soil mixture for poinsettias should provide good drainage, yet have good water holding capacity. In this Learning Activity Package you will learn how to prepare a soil mixture for growing poinsettias.

DIRECTIONS

Read the objective below. If you think that you are already able to perform these tasks, read the Check-Out Activities. Then either arrange with your instructor about doing the Check-Out Activities,

or

If you need further preparation in order to do the tasks, go through the Learning Activities.

OBJECTIVE

Select and prepare a recommended soil mixture for poinsettias.

LEARNING ACTIVITIES

1 READ the following: *Greenhouse Crop Production*, The Pennsylvania State University Press, pp. 87, and Preparing a Soil Mixture For Poinsettias.

2. CHECK YOUR KNOWLEDGE by taking the Student Self-Check.

3. OBSERVE another student as he or she prepares a soil mixture.

4. PRACTICE preparing a small batch of soil mixture.

5. ARRANGE with your instructor to complete this learning activity package by going through the Check-Out Activity.

TOOLS AND EQUIPMENT

1. Soil mixer (concrete mixer may be used for this purpose)
2. Shovels
3. Wheelbarrow

SUPPLIES AND MATERIALS

1. Loamy soil
2. Peat
3. Perlite

SAFETY

Exercise caution when using the cement mixer for mixing soil. The shovel can become caught in the mixer and create a safety hazard.

INSTRUCTIONS

SELECTING AND PREPARING A SOIL MIXTURE FOR POINSETTIAS

1. What is the best soil mixture for growing poinsettias?

   Poinsettias are being grown in a relatively wide variety of soil mixtures. Probably, the most satisfactory mix is one that contains equal parts of perlite, peat moss and topsoil. This mixture allows the good drainage needed for poinsettias but yet has the good water holding capacity.

2. Should the soil mixture be sterilized?

   The soil mixture should definitely be sterilized; sterilization will combat pests that might be in the soil mixture, e.g. weeds, insects, and diseases. Also, sterilization may improve the soil mixture drainage and aeration. See Learning Activity Package Number 22. for more information on sterilization.

4. How is the soil mixture sterilized?

   Steam sterilization is recognized as the best method for soil sterilization. Most schools do not have steam sterilizers for the greenhouse but a small steam jenny used in a mechanics shop can do the job. With the instructor's assistance, the class may build a small box that can be used for steam sterilization with a small steam jenny. The soil should be heated with steam to a temperature of 180 degrees F (82 degrees C) and kept at that temperature for 30 minutes. It is important not to overheat because beneficial organisms might be killed. Some chemicals might be used for sterilizing, but these should be used only with instructor supervision; methyl bromide is the most commonly used chemical soil sterilant, but all safety precautions on the label must be followed. Note: If you plan to sterilize a mixture you should first complete Learning Activity Package Number 22.

5. How is the soil mixture prepared for poinsettias?

   The ideal mixer for soil mixtures is a concrete mixer. The different ingredients can be proportioned into the mixer by simply adding a shovel of perlite, a shovel of peat moss and a shovel of topsoil until the mixer is filled. Then, the mixer is turned on and allowed to turn until the ingredients are well mixed. If there is not a mechanical mixer available, the soil mixture can be porportioned into an empty wheel barrow and then thoroughly mixed by hand with a shovel and a hoe.

STUDENT SELF-CHECK

DO NOT WRITE ON THIS SHEET

SELECTING AND PREPARING A SOIL MIXTURE FOR POINSETTIAS

Directions: Circle the letter for the phrase that best finishes the sentence.

1. A good soil mixture for poinsettias is:

   a. sand and peat moss
   b. perlite and sand
   c. perlite, peat moss and topsoil
   d. sand, vermiculite, and perlite

2. The best method of preparing a soil mixture for poinsettias is by using:

   a. a concrete mixer
   b. a feed mixer
   c. an old seed cleaning machine
   d. a wheel barrow

3. The recommended soil mixture is:

   a. one part sand to 2 parts soil
   b. one part sand to 2 parts peat and one part perlite
   c. equal parts of topsoil, peat moss and perlite

4. Soil media for poinsettias does not have to be sterilized because the cuttings are now large enough to protect themselves from disease.

   True
   False

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next learning activity.

CHECK-OUT ACTIVITY

In order to finish this learning activity package you must be able to complete the task(s) listed below. As you go through each activity, your instructor will rate your performance using the Instructor's Final Checklist.

Select and prepare a soil mixture for poinsettias.

CORRECT RESPONSES

1. c
2. a
3. c
4. False

DO NOT WRITE ON THIS SHEET

LAP 3

Student ____________________

Date ____________________

SELECTING AND PREPARING A SOIL MIXTURE FOR POINSETTIAS

Instructor's Final Checklist

Check the student's performance in the following elements of selecting and preparing a soil mixture for poinsettias.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. Student can list at least one reference giving information on soil mixtures	[ ]	[ ]	[ ]	[ ]
2. Student used peat moss, perlite and topsoil ingredients for soil mixture	[ ]	[ ]	[ ]	[ ]
3. Student mixed the above three materials using the ratio 1:1:1	[ ]	[ ]	[ ]	[ ]
4. Student operated mixer according to manufacturer's directions	[ ]	[ ]	[ ]	[ ]

Learning Activity Package No. 4

GREENHOUSE PRODUCTION

FALL SEQUENCE

TRANSPLANTING POINSETTIA CUTTINGS

Ornamental Horticulture

INTRODUCTION

Transplanting poinsettias from the propagation bed to pots or pans requires knowledge and skill. Decisions as to when the plants are ready for transplanting and in what size pot or pan they are to be planted must be made. The procedures or methods to be used in handling the rooted cuttings (liners) must be carefully planned and followed. In this learning activity package, you will learn how to transplant rooted cuttings.

DIRECTIONS

Read the objective below. If you think that you are already able to perform these tasks, read the Check-Out Activities. Then, either arrange with your instructor about doing the Check-Out Activities,

or

If you need further preparation in order to do the tasks, go through the Learning Activities.

OBJECTIVE

Transplant rooted cutting in accordance with industry standards.

LEARNING ACTIVITIES

1 READ the following: *Flower and Plant Production*, Nelson, K.S., pp. 273-274.

The Ball Red Book, George J. Ball, Inc., pp. 414-516.

Greenhouse Crop Production, The Pennsylvannia State University, pp. 92-93.

2 READ Transplanting Rooted Poinsettia Cuttings.

3 CHECK YOUR KNOWLEDGE by taking the Student Self-Check.

4 OBSERVE another student as she or he transplants a rooted poinsettia cutting.

5 PRACTICE transplanting rooted poinsettia cutting.

6 ARRANGE with your instructor to complete this learning activity package by going through the Check-Out Activity.

TOOLS AND EQUIPMENT

1. Hand trowels
2. Carrying trays

SUPPLIES AND MATERIALS

1. Rooted poinsettia cuttings (liners)
2. Pans (clay pots that are not as deep as they are wide)
3. Soil mixture
4. Dexon
5. Benlate or Terraclor

SAFETY

Use fungicides only under the supervision of your instructor.

INSTRUCTIONS

TRANSPLANTING ROOTED POINSETTIA CUTTINGS

1. When are poinsettia liners ready for transplanting?

   It was stressed in Learning Activity Package Number 2 that poinsettia cuttings should be taken in late August or early September and that the cuttings should be ready to transplant about four weeks later. By industry standards, transplanting should occur as soon as possible after root formation so that there will be a minimal amount of shock due to root disturbance. Poinsettias are a seasonal crop; therefore, it is extremely critical that the bracts have color prior to Christmas. The poinsettia grower must plan the transplanting dates so that the plants are saleable by Christmas. A good rule of thumb for transplanting poinsettia liners is that the liners should be in the finishing pot around October 1.

2. What kind of containers are best for poinsettias?

   Poinsettias are usually sold in clay pots called "pans." A pan is simply a pot that has an inside depth that is less than the inside diameter, i.e., the pan is wider than it is tall. Azalea pots or bulb pots may be used for poinsettia finishing if regular pans are not available. The more standard size for poinsettia pans is 5 or 8 inches (13 or 20 cm).

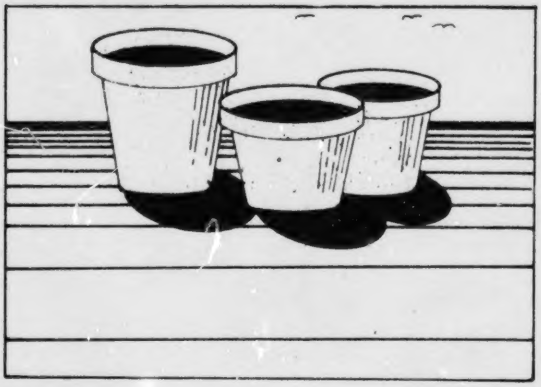


Figure 1. Poinsettias can be potted in pots or pans. Pans are pots that are wider than they are tall.

3. How deep should the liner be placed in the pan?

   It is very important to remember to transplant the liners to the same depth as they were rooted. Transplanting either deeper or more shallow might cause problems that would cause the crop to not be ready for Christmas sales.

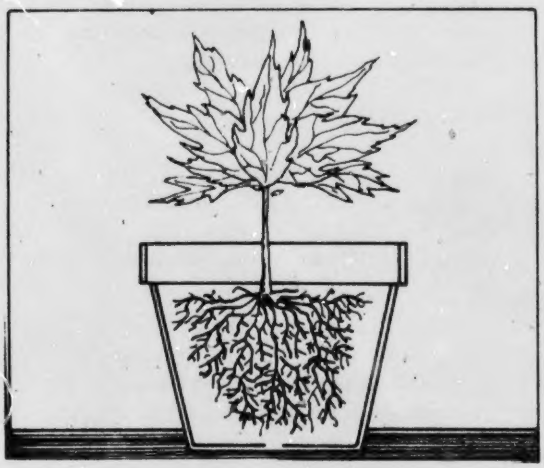


Figure 2. Depth of transplant should be the same as rooting bed depth.

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4. How many liners should be transplanted to a pan?

The number of liners transplanted to a pan may vary, but most commonly three liners per 6 in. (15 cm) pan are used. It should be stressed that the larger the pan, the more liners per pan. Liners should be sized by sight and liners of the same size should be used in a pan so that there will be uniformity in the final plant size and also uniformity of time for the bract color change. Liners of the same weight, leaf area, and stem diameter are grouped together for purposes of transplanting.

5. What care should poinsettias be given immediately after they are transplanted?

The pans should be drenched immediately after transplanting to protect against accidental contamination during the transplanting operation. The worker should use Dexon (read label for strength) and Benlate or Terrachlor (read label for strength). The Dexon drenches should be continued at 30-day intervals, but the Benlate or Terrachlor can be omitted after the initial drenching. The pans should be spaced on the greenhouse benches according to pan size. A 6 inch (15 cm) pan should have about 1½ sq. ft. (.14 sq. m) of area. Watering is extremely critical after transplanting. The growing media should be kept uniformly moist. Shading may be necessary for the first two or three days after transplanting to prevent rapid evaporation.

6. Where can I get more information about poinsettia containers and transplanting poinsettias?

The Ball Red Book is recommended for further studies. This book has a very thorough discussion on poinsettia production and may be used to answer any questions not covered in this package.

STUDENT SELF-CHECK
DO NOT WRITE ON THIS SHEET
TRANSPLANTING ROOTED POINSETTIA CUTTINGS

Directions: Circle the letter of the phrase that best finishes the following statements.

1. After the poinsettia cuttings are stuck, they are usually ready to transplant in about

   a. 2 weeks
   b. 4 weeks
   c. 5 weeks
   d. 6 weeks

2. A good rule of thumb is that the poinsettia liners are transplanted to the finishing container around

   a. September 1
   b. September 15
   c. October 1
   d. November 1

3. Poinsettias are usually sold in clay pots called

   a. Market-paks
   b. flats
   c. Kys-Kubes
   d. pans

4. The more commonly-used transplanting rule is

   a. 3 liners per 6 in. (15 cm) pan
   b. 1 liner per 6 in. (15 cm) pan
   c. 2 liners per 6 in. (15 cm) pan
   d. 3 liners per 4 in. (10 cm) pan

5. How deep should poinsettia liners be set?

   a. 3 inches (8 cm)
   b. 4 inches (10 cm)
   c. same depth as in rooting bench
   d. 2 inches (5 cm) deeper than in rooting bench

6. Immediately after transplanting, poinsettias should be drenched with:
   - a. Dexon and Benlate or Terrachlor
   - b. Dexon and Cygon or Isotox
   - c. Benlate and Paraquat or 2,4-D Amine
   - d. Terrachlor and Dowpon or Dalpon

7. The spacing requirement for poinsettias on the greenhouse bench is:
   - a. 3 sq. ft. (.27 sq. m) per 6 in. (15 cm) pan
   - b. 2 sq. ft. (.18 sq. m) per 6 in. (15 cm) pan
   - c. 1 sq. ft. (.09 sq. m) per 6 in. (15 cm) pan
   - d. 1½ sq. ft. (.14 sq. m) per 6 in. (15 cm) pan

8. Poinsettias may need some shading for:
   - a. 1 week
   - b. 2–3 days
   - c. 2–3 weeks
   - d. 1 month after they have been panned

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next learning activity.

CHECK-OUT ACTIVITY

In order to finish this learning activity package you must be able to complete the task(s) listed below. As you go through each activity, your instructor will rate your performance using the Instructor's Final Checklist.

Transplant rooted poinsettia cuttings.

CORRECT RESPONSES

1. b
2. c
3. d
4. a
5. c
6. a
7. d
8. b

DO NOT WRITE ON THIS SHEET

LAP 4

Student ______________________

Date ______________________

TRANSPLANTING ROOTED POINSETTIA CUTTINGS

Instructor's Final Checklist

Check the student's performance in the following elements of transplanting rooted poinsettia cuttings.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. Student chose rooted cuttings which were mature enough for transplanting	☐	☐	☐	☐
2. Student chose appropriate size and type container for the liners	☐	☐	☐	☐
3. Student placed the liners at the same depth in the pan as they were in the propagation bed	☐	☐	☐	☐
4. Student watered and drenched transplants shortly after transplanting	☐	☐	☐	☐
5. Student selected appropriate drenching material	☐	☐	☐	☐
6. Student arranged for shading for 2 or 3 days after transplanting	☐	☐	☐	☐

Learning Activity Package No. 5

GREENHOUSE
PRODUCTION

FALL SEQUENCE

GROWING POINSETTIAS

Ornamental Horticulture

INTRODUCTION

Like the links of a chain, all phases of poinsettia production are critical, but growing the crop after it is rooted and potted is perhaps the most demanding aspect of production. Such environmental factors as light, heat and moisture require close attention. This learning activity package will provide information which will help you in selecting recommended environmental controls for growing poinsettias.

DIRECTIONS

Read the objective below. If you think you are ready to perform this task, read the Check-Out Activity. Then, arrange with your instructor to complete the Check-Out Activity.

or

If you need further preparation in order to do the tasks, go through the Learning Activities.

OBJECTIVE

Given a crop of poinsettias already rooted and potted and the greenhouse facilities and supplies needed, grow a crop of poinsettias such that they are of acceptable market quality and are ready for sale at least 2 weeks before Christmas.

LEARNING ACTIVITIES

1 READ *Greenhouse Flower and Bedding Plants for Agribusiness Studies*, Williams, G.S., pp. 35-39.

2 READ *Flower and Plant Production in the Greenhouse*, Nelson, Kennard S., pp. 271-279.

3 READ the Instructions, GROWING POINSETTIAS.

4 CHECK YOUR KNOWLEDGE by using the Student Self-Check.

5 ARRANGE with your instructor to complete this learning activity package by going through the Check-Out Activity.

TOOLS AND EQUIPMENT

Greenhouse equipped to grow poinsettias

SAFETY

Observe all safety precautions when applying pesticides in a greenhouse.

INSTRUCTIONS

GROWING POINSETTIAS

Spacing

Place the potted or panned (pans are pots which are not as deep as regular pots) poinsettias pot to pot on the greenhouse benches. Benches should have a hardware cloth bottom to provide good drainage. Move the pots further and further apart as growth increases. At least two square feet (.18 sq. m) of bench space will be needed per pot or pan at maturity.

Watering

Water plants with the "ooze" type individual and automatic watering system if available. If an automatic watering system is not available or if the number of plants to be grown is small, hand watering can be used. Watering should be done when the soil feels dry to the touch. When watering is done it should be thorough. The pot or pan should be filled to the rim twice. If poinsettias are watered semiautomatically (i.e., the water system is hand operated) each plant should receive 1 cup of water each day.

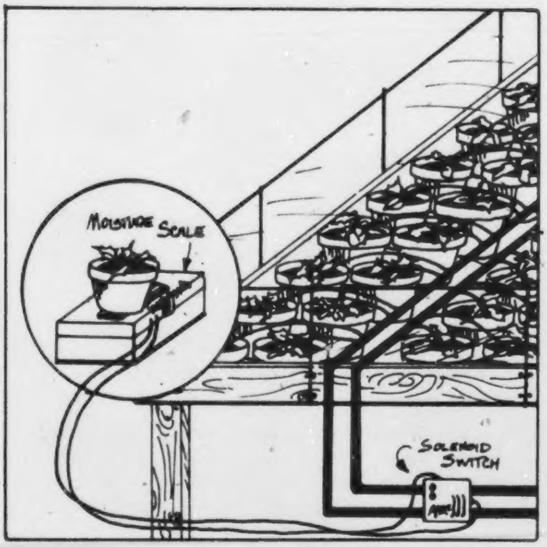


Figure 1. A system of providing water for each pot. Note that the plant setting on the scale regulates the water for all plants.

Fertilizing

Poinsettias can be fertilized through the automatic watering system on an every watering (constant feed) basis or on a weekly basis. For the constant feed system, 15-10-30 fertilizer is mixed with water at the rate of 18 ounces per gallon (135 g/l). This stock solution (concentrated solution) is then diluted through a metering device at a 1:100 dilution ratio. If plants are to be fertilized on a weekly basis, each plant is given 1 cup (8 ounces = 236 cc) of a solution made up of 1 ounce (28 g) of 20-20-20 fertilizer in each 2 gallons (8 l) of water.

Controlling Temperature

Day temperatures for poinsettias should not exceed 80° F (27° C). Night temperatures should be held between 60° -62° F (15° -17° C). Lower temperatures result in slower growth, more disease problems, and early branching. Flower bud development will be retarded if night temperatures are allowed to go above 65° F (18° C) during the flower bud development stage (September 20-October 20). After bud formation, higher night temperatures may be used to expedite (speed up) the crop. A brighter red bract color can be obtained by lowering the temperature to 55° -58° F (13° -14° C) during the two-weeks preceding sale.

Pinching

Pinching involves the removal of about one-half to one inch (2.54 cm) of the growing stem tip. This is usually done with the fingers and, hence, the term pinching. Pinching results in the formation of several buds and more branching. If 3 or 4 inches (8-10 cm) of the growing tip is removed, the portion removed is used for propagation. This procedure, known as a hard pinching aid, is done usually between August 1 and August 25. Soft pinching can be done up until three weeks before flower bud formation. Flower bud formation takes place between September 20 and October 20.

Regulating Growth

Poinsettias often become too tall if growth is not checked. Height can be controlled by pinching, by restricting water and by treating with a chemical growth retardant. A combination of the means may be necessary. Usually, growth can be controlled by restricting water or by pinching, but if these measures fail the growth retardant chemical, cycocel, can be applied. Use manufacturers directions for formulating and applying this solution.

Controlling Day Length

Poinsettias are sometimes given artificially long days in the fall to delay flowering until Christmas. Artificial long days are provided by lighting each night for two hours during the period September 20 to October 5. Accidental lighting of poinsettias at night during the late fall can delay flower formation. A street lamp which burns all night near a greenhouse will prevent flower formation.

STUDENT SELF-CHECK
DO NOT WRITE ON THIS SHEET
GROWING POINSETTIAS

Answer the following:

1. How much bench space is required for each poinsettia at market time?

   a. ½ square foot (.05 sq. m) per plant
   b. 1 square foot (.09 sq. m) per plant
   c. 1½ square feet (.14 sq. m) per plant
   d. 2 square feet (.18 sq. m) per plant

2. The ideal night temperature range for growing poinsettias is:

   a. 50° -55° F (10° -13° C)
   b. 55° -57° F (13° -14° C)
   c. 60° -62° F (15° -17° C)
   d. 65° -70° F (18° -21° C)

3. Pinching

   a. increases height
   b. increases flower bud formation

4. Artificial lighting is sometimes used with a poinsettia crop because flower bud formation is:

   a. increased with added day length
   b. decreased with added day length
   c. delayed with added day length

5. Higher night temperature, over 65° F (18° C) is sometimes used to:

   a. delay the crop
   b. expedite the crop

6. Day temperatures for poinsettias should not exceed:

   a. 70° F (21° C)
   b. 80° F (27° C)
   c. 90° F (32° C)
   d. 100° F (38° C)

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next learning activity.

CHECK-OUT ACTIVITY

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through this activity, your instructor will rate your performance using the Instructor's Final Checklist, GROWING POINSETTIAS.

Grow a given quantity of poinsettias.

CORRECT RESPONSES

1. d
2. c
3. b
4. c
5. b
6. b

DO NOT WRITE ON THIS SHEET

LAP 5

Student ______________________

Date ______________________

GROWING POINSETTIAS

Instructor's Final Checklist

Check the student's performance in the following elements of growing poinsettias.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. Pots adequately spaced (at least 2 sq. ft.(.18 sq. m) per plant provided at maturity)	☐	☐	☐	☐
2. Plants watered thoroughly at each watering (pots filled to rim twice)	☐	☐	☐	☐
3. Plants fertilized with recommended fertilizer analysis (15-10-30)	☐	☐	☐	☐
4. Concentrated solution (stock solution) mixed at 18 ounces fertilizer per gallon (135 g per l) of water.	☐	☐	☐	☐
5. Concentrated solution (stock solution) applied to plants at 1:100 ratio.	☐	☐	☐	☐
6. Day length regulated to delay flowering if needed.	☐	☐	☐	☐
7. Proper night temperature range selected (60° -62° F) (15° -17° C)	☐	☐	☐	☐
8. Plant was pinched before flower bud set (September 20-October 20)	☐	☐	☐	☐
9. Plants protected from accidental night lighting which would prevent flower bud formation.	☐	☐	☐	☐
10. Day temperatures kept at 80° F (27° C) or below.	☐	☐	☐	☐

Learning Activity Package No. 6

GREENHOUSE
PRODUCTION

WINTER SEQUENCE

SELECTING A WINTER GREENHOUSE CROP

Ornamental Horticulture

INTRODUCTION

Some greenhouse growers are specialty growers, i.e., they grow only one or two major crops and grow these crops continuously throughout the year. For example, a producer may grow only chrysanthemums. New crops of mums are continuously being started while the maturing crops are being sold. Crops grown year-round in this manner are crops which are in demand year-round. However, some crops – poinsettias for example – are marketed only during the Christmas season. If a grower were to produce only poinsettias, the greenhouse would remain idle for much of the year. For this reason, most growers who grow crops such as poinsettias select other crops to grow while the greenhouse is not being used. Since poinsettias are grown in the fall and sold at Christmas and since Easter lilies (or other bulb crops) are grown during the winter and sold at Easter the two crops are frequently grown in sequence. Actually, a third crop – bedding plants – is usually added as a third crop in the sequence since they can be grown after the winter sequence crop. Therefore growers, in order to obtain the maximum use of greenhouses, use a fall, winter, and spring sequence of crops.

Easter lilies, daffodils, hydrangea, tulips, amaryllis and hyacinths are bulb crops which can be grown in the winter sequence. The selection of a crop or combination of these crops for production during the winter sequence is very important. This package will help you in making such a selection.

DIRECTIONS

Read the objective below. If you think that you are already able to perform these tasks, read the Check-Out Activities. Then, either arrange with your instructor about doing the Check-Out Activities,

or

If you need to complete learning activities in order to be able to do the tasks, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVE

When given a variety of winter crops, identify those most profitably grown in the local area.

LEARNING ACTIVITIES

1 READ one or more of the following references:

Ball Red Book, George J. Ball, Inc., 13th edition, pp. 375-377.

Flower and Plant Production In the Greenhouse, K.S. Nelson. 1967, pp. 268-271.

Greenhouse Flowers and Bedding Plants for Agribusiness Studies, G.S. Williams, 1975, pp. 15-17, 34.

2 READ – SELECTING A WINTER GREENHOUSE BULB CROP.

3 LIST several references which could be used to help select a winter bulb crop.

4 CHECK your knowledge by taking the Student Self-Check.

5 ARRANGE with your instructor to complete this learning activity package by going through the Check-Out Activity.

TOOLS AND EQUIPMENT

None

MATERIALS AND SUPPLIES

Reference materials

SAFETY

Not applicable

INSTRUCTIONS

SELECTING A WINTER GREENHOUSE CROP

1. Which crops are more commonly grown as a winter sequence crop?

   A winter sequence crop is grown primarily for Easter. By far the flower in greatest demand for this occasion is the Easter lily. Daffodils, hyacinths, tulips and amaryllis are also popular Easter flowers and fit well into the winter sequence.

2. What factors should be considered in selecting a bulb crop?

   Several factors must be considered. Profitability is high on every growers list. To determine profitability, demand and cost production must be compared. The crop must fit into the greenhouse sequence. Also the crop must reach a marketable size by a week before Easter. The most popular bulb crop grown is the Easter lily. The Easter lily will be used as the winter sequence bulb crop in these learning activity packages. Daffodils, hyacinths, tulips or other bulb crops could be used as a winter greenhouse crop.

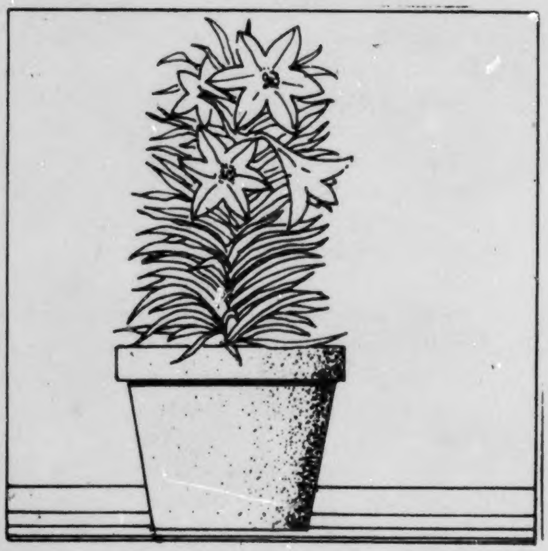


Figure 1. The Easter lily is the most popular potted plant for spring greenhouse production.

]

3. What variety of Easter lily is most popular?

The "Ace" and "Nellie White" varieties are by far the most popular varieties grown. Another variety, Georgia lilies, are popular as cut flowers and can sometimes be sold as potted lilies. The Georgia variety has long stems and more flowers than the Ace or Nellie White. The Georgia and Estate varieties are popular varieties in the South.

4. Why are winter sequence crops usually bulb crops?

Winter sequence crops do not have to be bulb crops, however, bulb crops are often used by greenhouse growers in this time period for the following reasons:

a. The Easter lily is the traditional Easter flower and must be grown in greenhouses to be available at this season in most states.

b. There is a good demand for early flowering bulbs to be used indoors.

c. Most bulbs can be grown in the time period between December and April or May.

d. Bulbs can be potted and stored under the greenhouse benches. The fall crops are marketed at the Christmas Season.

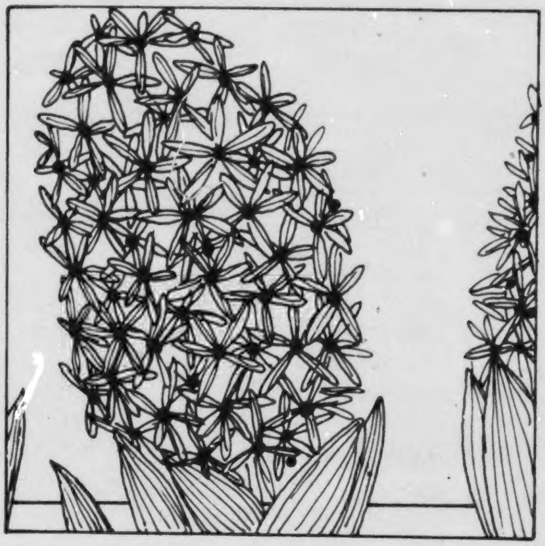


Figure 3. Hyacinth

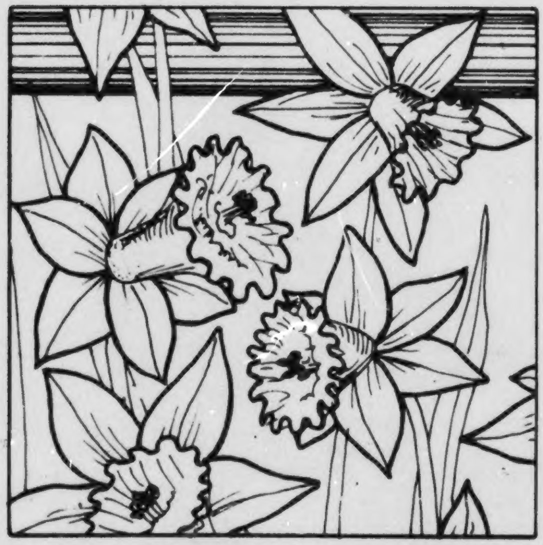


Figure 2. Daffodils

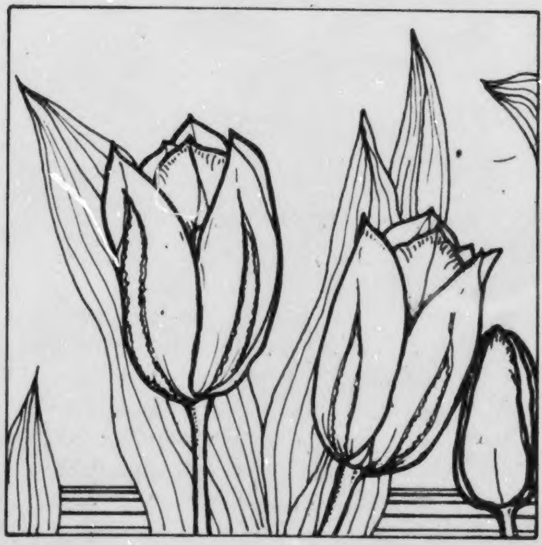


Figure 4. Tulips

STUDENT SELF-CHECK

DO NOT WRITE ON THIS SHEET

SELECTING A WINTER GREENHOUSE BULB CROP

1. Which of the following would be suitable as a winter sequence bulb crop?

   a. Poinsettia
   b. Chrysanthemum
   c. Easter lily
   d. Daffodil
   e. Hyacinth

2. Which of the following lily varieties is most popular?

   a. Ace and Nellie White
   b. Caroline
   c. Georgia

3. Why are bulb crops ideal for the winter greenhouse sequence.

Compare your answers with the correct responses on this page. Review any incorrect answers before going on to the next learning activity.

CORRECT RESPONSES

1. c, d, e
2. a
3. a. They can be started under benches of fall crop
   b. They mature in time for the spring crop
   c. There is usually a good market for these crops at Easter

CHECK-OUT ACTIVITY

In order to finish this learning activity package you must be able to complete the task(s) listed below. As you go through each activity, your instructor will rate your performance using the Instructor's Final Checklist.

Select a winter greenhouse bulb crop.

DO NOT WRITE ON THIS SHEET

LAP 6

Student ____________________

Date ____________________

SELECTING A WINTER GREENHOUSE BULB CROP

Instructor's Final Checklist

Check the student's performance in the following elements of selecting a winter greenhouse bulb crop.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. Student can name at least one publication useful in selecting a winter greenhouse crop	[ ]	[ ]	[ ]	[ ]
2. Student can list several crops commonly used in the winter sequence	[ ]	[ ]	[ ]	[ ]
3. Student can explain why a bulb crop is preferred for the winter sequence	[ ]	[ ]	[ ]	[ ]

Learning Activity Package No. 7

GREENHOUSE
PRODUCTION

WINTER SEQUENCE

PREPARING A SOIL MIXTURE FOR A TYPICAL WINTER GREENHOUSE CROP

Ornamental Horticulture

INTRODUCTION

For any greenhouse crop to grow satisfactorily the soil must provide water, nutrients, air, and physical support. Soils that drain freely are more suitable for greenhouse production. A variety of soil media, such as peat, perlite, or vermiculite can be combined to provide the proper soil structure necessary for growth. This package will assist you in preparing a typical potting mixture for growing Easter lilies.

DIRECTIONS

Read the objective below. If you think that you are already able to perform these tasks, read the Check-Out Activities. Then, either arrange with your instructor about doing the Check-Out Activities,

or

If you need further preparation in order to do the tasks, go through the Learning Activities.

OBJECTIVE

Select and prepare a recommended potting mixture for Easter lilies.

LEARNING ACTIVITIES

1 READ one of the following references:

Ball Red Book, George J. Ball, Inc., 13th edition, p. 380.

Flower and Plant Production in the Greenhouse, K.S. Nelson, p. 207.

Greenhouse Flowers and Bedding Plants for Agribusiness Studies, G.S. Williams, 1975, pp. 43-45.

2 READ the Instructions, SELECTING A POTTING MIXTURE FOR LILIES.

3 PREPARE a potting mixture by following the procedure provided in this learning activity package.

4 TEST your knowledge of preparing a soil mixture for a typical winter greenhouse crop by taking the Student Self-Check.

5 OBSERVE another student as he or she satisfactorily performs or is checked out on this package.

6. ARRANGE with your instructor to complete this Learning Activity Package by going through the Check-Out Activity.

TOOLS AND EQUIPMENT

Soil mixer
Shovel

MATERIALS AND SUPPLIES

Sterilized soil
Coarse material (peat, straw, etc.)
Agricultural limestone, hydrated lime, or gypsum

SAFETY

Don't get the shovel caught in the soil mixer! Wear gloves when handling fertilizers. Fertilizer can burn skin if it comes in contact with the body.

INSTRUCTIONS

SELECTING A POTTING MIXTURE FOR LILIES

1. Measure out equal amounts of peat, sand and sterilized top soil. A good soil for a crop of lilies could consist of one-third coarse peat, one-third sharp sand and one-third sterilized soil. It is important to maintain a pH of between 6.5 to 7.0. Lilies need a soil slightly acidic. If the pH is less than 6.5, sufficient lime must be added to raise the pH to at least 6.5.

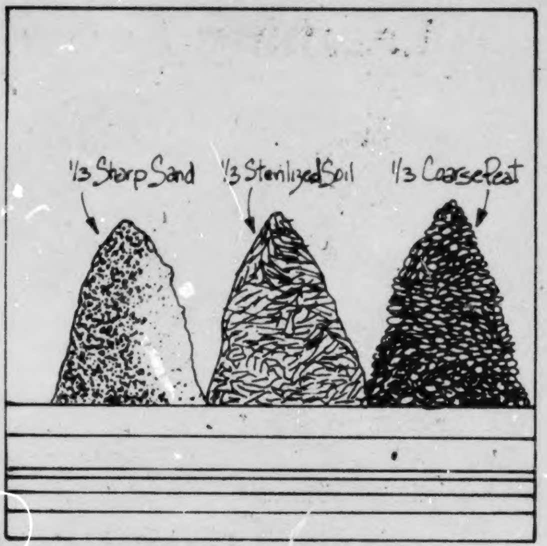


Figure 1. A commonly used media mix for potting bulbs – 1/3 sharp sand, 1/3 sterilized soil and 1/3 coarse peat.

2. Mix these ingredients in a container such as a wheelbarrow or on a concrete floor. A hoe, shovel or rake can be used for mixing.

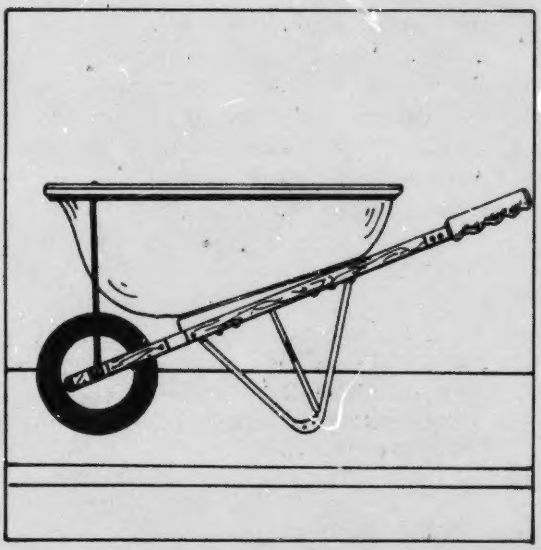


Figure 2. Small quantities of media can be mixed in a wheel barrow.

3. If only a small amount is to be mixed it can be mixed on a bench or table using a small scoop or trowel.

4. If large quantities are to be mixed, a cement mixer may be used.

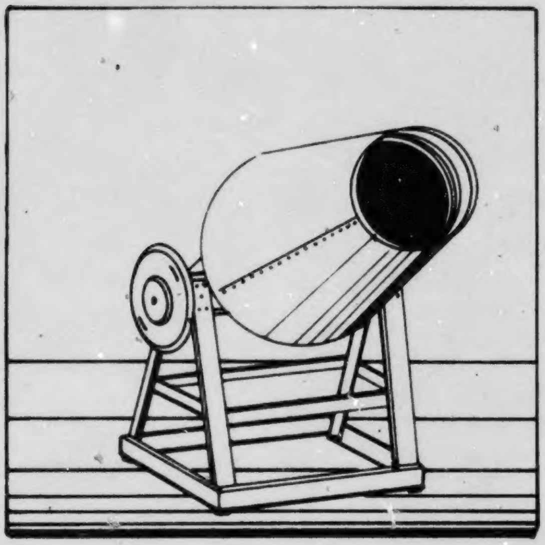


Figure 3. A cement mixer can be used to mix media

STUDENT SELF-CHECK

DO NOT WRITE ON THIS SHEET

PREPARING A SOIL MIXTURE FOR A TYPICAL WINTER GREENHOUSE CROP

1. Soil for potting lilies should be:
   - a. sandy
   - b. compact
   - c. relatively coarse
   - d. relatively fine

2. A soil for potting lilies should have a pH between:
   - a. 7.0-8.0
   - b. 7.0-7.5
   - c. 6.5-7.0
   - d. 0-6.5

3. List three materials suitable for use as a propagation media.

Compare your answers with the correct responses on this page. Review any incorrect answers before going on to the next learning activity.

CHECK-OUT ACTIVITIES

In order to finish this learning activity package you must be able to complete the task(s) listed below. As you go through each activity, your instructor will rate your performance using the Instructor's Final Checklist, PREPARING A SOIL MIXTURE FOR A TYPICAL GREENHOUSE CROP.

Prepare a soil mixture for a typical winter greenhouse crop.

CORRECT RESPONSES

1. c
2. c
3. sand, perlite, top soil

DO NOT WRITE ON THIS SHEET

LAP 7

Student ____________________

Date ____________________

PREPARING A SOIL MIXTURE FOR A TYPICAL WINTER GREENHOUSE CROP

Instructor's Final Checklist

Check the student's performance in the following elements of preparing a soil mixture for a typical winter greenhouse crop.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. Student named at least one source of information for preparing soil media for winter crops	☐	☐	☐	☐
2. Potting mixture contained the right ingredients in correct amounts	☐	☐	☐	☐
3. Potting mixture had coarse texture	☐	☐	☐	☐
4. Potting mixture had pH between 6.5 and 7.0.	☐	☐	☐	☐

Learning Activity Package No.8

GREENHOUSE
PRODUCTION

WINTER SEQUENCE

POTTING A BULB CROP

Ornamental Horticulture

INTRODUCTION

The process of potting bulb crops is an important step in obtaining a healthy crop. A bulb potted too shallow may be exposed to the air which may cause the bulb to dry out. A bulb planted too deep may take longer to sprout, or there may not be enough soil beneath the bulb to support a healthy root system. In this learning activity package you will learn how to pot a bulb crop.

DIRECTIONS

Read the objective below. If you think that you are already able to perform these tasks, read the Check-Out Activities. Then, either arrange with your instructor about doing the Check-Out Activities,

or

If you need further preparation in order to do the tasks, go through the Learning Activities.

OBJECTIVE

Pot a selected bulb crop in a manner that complies with industry practices.

LEARNING ACTIVITIES

1 READ one or more of the following references:

Ball Red Book, George J. Ball, Inc., 13th edition, p. 380.

Flower and Plant Production In The Greenhouse, K.S. Nelson, 1967, pp. 207-212.

Greenhouse Flowers and Bedding Plants for Agribusiness Studies, G.S. Williams, 1975, pp. 43-49.

2 OBSERVE the potting operation at a local greenhouse.

3 READ the Procedure, Potting a Lily Crop.

4 READ instructions for potting a bulb crop.

5 PRACTICE potting a bulb crop.

6 OBSERVE another student as he or she satisfactorily performs or is checked out on this package.

7 ARRANGE with your instructor to complete this learning activity package by going through the Check-Out Activity.

TOOLS AND EQUIPMENT

Spade

MATERIALS AND SUPPLIES

Potting containers
Potting soil
Lily bulbs
Small stones or pebbles

SAFETY

Not applicable

INSTRUCTIONS

POTTING A BULB CROP

1. When should lily bulbs be potted?

   Approximately 115 days are required to grow a crop of Easter lilies using a growing temperature of 60 degrees F (15.6 degrees C) therefore, the potting date should be established by "backing-up" 115 days from the Easter date.

2. What types of containers can be used for potting bulb crops?

   There are many types of potting containers. Growers can select from plastic pots, which are light and easy to clean, clay pots which are heavy and porous, peat pots which make excellent transplant pots. Pots can be standard greenhouse flower pots (as tall as they are wide), azalea pots which are three-fourths as tall as they are wide, or bulb pans which are only one-half as tall as they are wide.

   Regardless of the type of container chosen, it must be large enough to accomodate a bulb and allow at least one inch (2.54 cm) of soil to surround the bulb. (See illustration.) The size of the container will depend on the bulb size. Bulbs may vary in size from 7–11 inches (17.78–27.94 cm) in circumference.

3. How is the soil arranged in a pot?

   Arranging soil in a pot is a simple but important task. Remembering that lilies must have good soil drainage, small stones and pebbles are placed on the bottom of the pot to a depth of about one inch (2.54 cm). The pot is then filled to the top of the pot with the media mix, smoothed and lightly pressed so that the top of the media is below the top edge of the pot, and settles to one-half inch (1.27 cm) after the first watering.

4. When should the pots be watered?

   The time for thorough watering is as soon as the bulb is potted. After the first watering the pots should be watered every 3–5 days or when the surface is dry to the touch.

5. How deep should the lily bulb be potted?

   The lily bulb produces roots from both the bottom of the bulb and the emerging stem, the bulb must have soil on all sides. At least two inches of soil covering the bulb is desirable, and at least one inch of soil should surround the sides and bottom of the bulb.

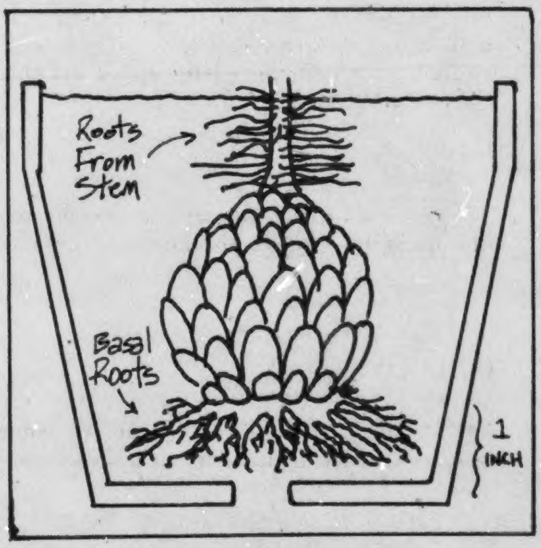


Figure 1. The ideal placement of the Easter lily bulb.

PROCEDURE

POTTING A LILY CROP

1. Select a container that is large enough to provide at least one inch of clearance on all sides of the bulb.
2. Place a handful of small stones or pebbles in the bottom of the container to insure good drainage.
3. Add about one inch of soil mixture.
4. Place the lily bulb nose up in the center of the pot. Completely cover the bulb with soil.
5. Add soil to fill the pot and gently tamp.

STUDENT SELF-CHECK

DO NOT WRITE ON THIS SHEET

POTTING A BULB CROP

Directions: answer the following true or false.

1. A potting container must be large enough to accommodate the bulb and at least one inch of soil around it. True False
2. A bulb should be potted nose down. True False
3. It is not necessary to arrange soil in a pot as long as the soil is coarse. True False
4. Pots should be watered when the bulb is potted and when the surface soil becomes dry to the touch. True False

Compare your answers with the correct responses on this page. Review any incorrect answers before going on to the next learning activity.

CHECK-OUT ACTIVITY

In order to finish this learning activity package you must be able to complete the task(s) listed below. As you go through each activity, your instructor will rate your performance using the Instructor's Final Checklist.

Pot a bulb crop in a manner that agrees with industry practices.

CORRECT RESPONSES

1. True
2. False
3. False
4. True

DO NOT WRITE ON THIS SHEET

LAP 8

Student ______________________

Date ______________________

POTTING A BULB CROP

Instructor's Final Checklist

Check the student's performance in the following elements of potting a bulb crop.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. The student selected appropriate potting container	[ ]	[ ]	[ ]	[ ]
2. Pebbles were placed to cover bottom of pot	[ ]	[ ]	[ ]	[ ]
3. One inch of soil was added (2.5 cm)	[ ]	[ ]	[ ]	[ ]
4. Bulb was placed nose up	[ ]	[ ]	[ ]	[ ]
5. Pot was filled with soil to top, and mixture was tamped	[ ]	[ ]	[ ]	[ ]

Learning Activity Package No. 9

GREENHOUSE
PRODUCTION

WINTER SEQUENCE

FERTILIZING BULB CROPS

Ornamental Horticulture

INTRODUCTION

Fertilizers serve to replace the nutrients plants remove from the soil in the growth process. A typical fertilizer contains nitrogen, potassium and phosphorus. The addition of these nutrients to the soil will help insure fast growth and hardy plants. In this learning activity package you will learn how to fertilize a typical winter bulb crop and plan a fertilizing schedule.

DIRECTIONS

Read the objective below. If you think that you are already able to perform these tasks, read the Check-Out Activities. Then, either arrange with your instructor about doing the Check-Out Activities,

or

If you need further preparation in order to do the tasks, go through the Learning Activities.

OBJECTIVES

Given a specific bulb crop, plan a fertilization schedule recommended for the crop specified.

Given the necessary ingredients and containers, prepare a fertilizer solution as recommended in the text of this learning activity package.

LEARNING ACTIVITIES

1. READ one or more of the following references:

   Ball Red Book, George J. Ball, Inc., 13th edition, pp. 381-382.

   Flower and Plant Production In The Greenhouse, K. S. Nelson, 1967, p. 269.

2. READ the Instructions, *A–FERTILIZING AN EASTER LILY CROP.*
3. READ the Instructions, *B – PREPARING A TYPICAL FERTILIZER SOLUTION.*
4. OBSERVE the fertilization methods used at a local greenhouse.
5. CHECK YOUR KNOWLEDGE by taking the Student Self-Check.

6 PREPARE a typical Easter lily fertilizing schedule by following the instructions.

7 ARRANGE with your instructor to complete this learning activity package by going through the Check-Out Activity.

TOOLS AND EQUIPMENT

Stirring rod
Mixing bucket

MATERIALS AND SUPPLIES

Fertilizer (high nitrogen (N) and potassium (K) content)
Gloves
Apron
Water

SAFETY

Remember ... Fertilizer can burn the skin and eyes and may be poisonous if swallowed.

INSTRUCTIONS

A – FERTILIZING AN EASTER LILY CROP

1. What fertilizers are available for Easter lilies?

   Most commercial growers use a complete fertilizer low in phosphate. A fertilizer such as 25-5-20 or 16-4-12 is readily available and excellent for Easter lilies.

2. How is a commercial fertilizer solution made?

   A fertilizer solution is prepared by careful measuring and mixing of ingredients. Too high a concentration of fertilizer will burn roots. A typical fertilizer solution consists of 1 lb. (.45 kg) of calcium nitrate to 40 gals. (152 l) of water. If the pH of the soil gets above 7.0, ammonium sulfate at the same rate as calcium nitrate is used. The two fertilizers may be used together at the rate of ½ lb. (.227 kg) each to 40 gals. (152 l) of water.

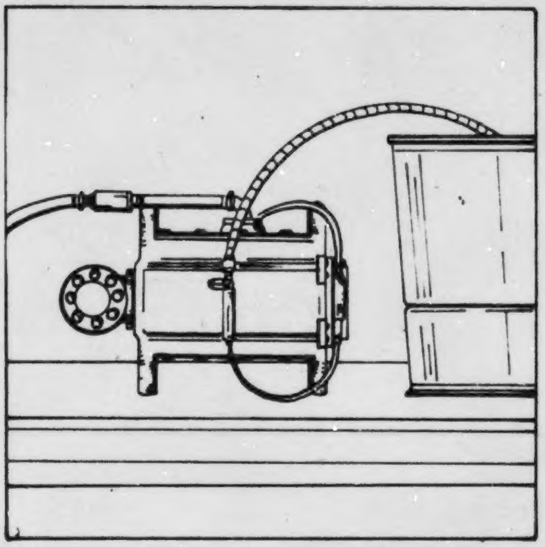


Figure 1. An injector or metering pump is sometimes used to inject the fertilizer solution into the watering system.

3. When and at what rate is the fertilizer solution applied?

   Fertilizing should not be started until the plant has a well developed root system and the top growth is about one and a half inches (3.81 cm) high. The first application should come in the second or third week of growth and applications continued weekly thereafter. The fertilizer should be applied at the rate of one-half pint (240 ml) per six inch (15 cm) pot. This is continued until the flowers are one-half inch (1.27 cm) long.

INSTRUCTIONS

B – PREPARING A TYPICAL FERTILIZER SOLUTION

1. Decide on the amount of fertilizer to be prepared. Your instructor will aid you in this decision.

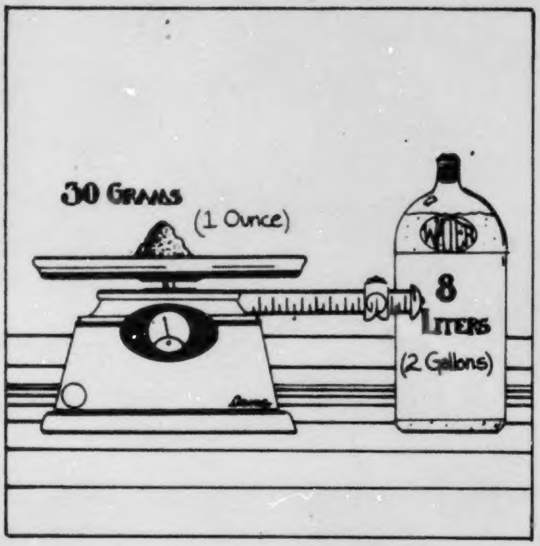


Figure 2. A typical fertilizer concentration for fertilizing bulb crops.

2. Using an empty plastic milk container, measure two gallons (7.6 liters) of water into a clean plastic bucket of sufficient size.

3. If a weighing balance is available weigh the fertilizer recommended (usually in ounces) to the water in the bucket. If no scale is available, add 12 teaspoons or 4 tablespoons for each ounce of fertilizer recommended.

4. Stir with a paint stirrer or other stirring utensil until the fertilizer is thoroughly dissolved.

5. Store unused fertilizer in a clean plastic milk container. Label the container with the fertilizer, the mixing ratio, and date the fertilizer solution was mixed.

STUDENT SELF-CHECK
DO NOT WRITE ON THIS SHEET
FERTILIZING BULB CROPS

Directions: Choose the letter of the phrase that best completes the statement.

1. A good fertilizer for Easter Lilies has:
    - a. very little nitrogen
    - b. a high amount of phosphorus
    - c. a large amount of nitrogen

2. Fertilizer should be applied:
    - a. daily
    - b. in excess so plants have plenty of it
    - c. on a weekly schedule
    - d. rarely

3. A typical fertilizer solution can be prepared by:
    - a. mixing 1 lb. (.45 kg) fertilizer with 10 gals. (38 l) water
    - b. mixing 1 lb. (.45 kg) fertilizer with 20 gals. (76 l) water
    - c. mixing 1 lb. (.45 kg) fertilizer with 40 gals. (152 l) water

Compare your answers with the correct responses on this page. Review any incorrect answers before going on to the next learning activity.

CORRECT RESPONSES

1. c
2. c
3. c

CHECK-OUT ACTIVITY

In order to finish this learning activity package you must be able to complete the task(s) listed below. As you go through each activity, your instructor will rate your performance using the Instructor's Final Checklist.

Plan a fertilization schedule for Easter Lilies.

Prepare a fertilizer solution.

DO NOT WRITE ON THIS SHEET

LAP 9

Student ______________________

Date ______________________

FERTILIZING BULB CROPS

Instructor's Final Checklist

Check the student's performance in the following elements of fertilizing crops.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

		Student Performance			
		Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1.	Student prepared fertilizing schedule	☐	☐	☐	☐
2.	Student obtained correct mixing ratio	☐	☐	☐	☐
3.	Student cleaned mixing containers before use	☐	☐	☐	☐
4.	Student prepared fertilizer solution using the rate of 1 lb. (.45 kg) fertilizer to 40 gals. (152 l) water	☐	☐	☐	☐
5.	Student stored excess fertilizer solution, marking date, mixing ratio and formula.	☐	☐	☐	☐
6.	Student cleaned mixing containers after use.	☐	☐	☐	☐

Learning Activity Package No. 10

GREENHOUSE
PRODUCTION

WINTER SEQUENCE

FORCING EASTER LILIES

Ornamental Horticulture

INTRODUCTION

As stated earlier, Easter Lilies are grown almost exclusively for Easter. To have a profitable crop the plants must be ready for market before Easter. If the plants are to be ready, their growth and flowering must be controlled. This activity package will introduce you to the methods used by commercial growers to control plant growth and flowering.

DIRECTIONS

Read the objective below. If you think that you are already able to perform these tasks, read the Check-Out Activities. Then, either arrange with your instructor about doing the Check-Out Activities,

or

If you need further preparation in order to do the tasks, go through the Learning Activities.

OBJECTIVE

Plan and use a forcing schedule for Easter lilies in such a manner that the crop is ready for market during the week before Easter.

LEARNING ACTIVITIES

1. READ one or more of the following references:

   Ball Red Book, George J. Ball, Inc., 13th edition, pp. 377-379.

   Flower and Plant Production In The Greenhouse, K.S. Nelson, 1967, pp. 268-271.

2. READ the Instructions, *FORCING EASTER LILIES.*
3. VISIT local greenhouses and find out how they force Easter lilies.
4. COMPLETE the Easter lily forcing schedule, filling in the appropriate dates for your time period.
5. CHECK your knowledge by taking the Student Self-Check, FORCING EASTER LILIES.
6. ARRANGE with your instructor to complete this learning activity package by going through the Check-Out Activity.

TOOLS AND EQUIPMENT

Not applicable

MATERIALS AND SUPPLIES

Potted bulbs from Learning Activity Package No. 8
Easter lily forcing schedule

SAFETY

Not applicable

INSTRUCTIONS

FORCING EASTER LILIES

1. How do commercial growers "force" crops?

   There are several methods used to control the growth of plants and "force" them to be ready for sale at a specific pre-determined date. If a plant is developing too slowly within the greenhouse, it is moved to a warmer area, if it is growing too fast, it is moved to a cooler area. Such proceedings are often required to keep the plants at the right stage of growth.

   Photoperiod treatment, or the length of time the plant is exposed to light, is used to control the height of the plant. To reduce height, the plants are given 8 hour days – to increase height, plants are given 16 hours of light. A pre-determined schedule must be followed in order to check the progress of growth and make any adjustments necessary in temperature or photoperiod. (See Chart I–EASTER LILY FORCING SCHEDULE)

2. Why are bulbs placed in cold storage before they are potted?

   Lily bulbs are pre-cooled because it takes less time for the plants to flower. They require a period of cold before they will sprout. If they are artifically cooled for a few weeks, the time required for flowering is reduced. The longer the bulbs are cooled the faster they can be flowered.

STUDENT SELF-CHECK

DO NOT WRITE ON THIS SHEET

FORCING EASTER LILIES

1. Moving a plant from a cooler to a warmer room induces:

   a. slower growth
   b. taller growth
   c. accelerated growth
   d. stunted growth

2. Increased photoperiod treatment will cause lilies to have:

   a. slower growth
   b. taller growth
   c. accelerated growth
   d. stunted growth

Compare your answers with the correct responses on this page. Review any incorrect answers before going on to the next learning activity.

CORRECT RESPONSES

1. c
2. b

CHECK-OUT ACTIVITY

In order to finish this learning activity package, you must be able to complete the task(s) listed below. As you go through each activity, your instructor will rate your performance using the Instructor's Final Checklist.

Force Easter lilies using a forcing schedule.

CHART I

EASTER LILY FORCING SCHEDULE

Date Wks.	Days Between Dates	Development	Temp. F	 C
1	7	bulbs potted, watered	55	12.8
2	7	roots form from soil ball	55	12.8
3	7	tops breaking soil surface	60	15.6
4	7	top growth 2-3 in. (5.08-7.62 cm)	60	15.6
5	7	top growth 4-6 in. (10.16-15.24 cm)	60	15.6
6	7	top growth 6-8 in. (15.24-20.32 cm)	60	15.6
7	7	top growth 10-12 in. (25.4-30.48 cm)	60	15.6
8	7	top growth 15 in. (38.1 cm) start photoperiod treatment*	60	15.6
9	7	buds can be felt	60	15.6
10-11	14	buds visible	60	15.6
12	7	buds 2-3in. (5.08-7.62 cm) long, bending down	60	15.6
13	7	buds 3-5 in. (7.62-12.7 cm) long	60	15.6
14	7	buds fully developed	50	10.0
15	3	buds whitening	50	10.0
Easter day	2	buds opening		

*Photoperiod treatment – to reduce height, give 8-hour days; to increase height, give 16-hour days. The Pennsylvania State University, *Greenhouse Crop Production*, University Park, PA: The University Press, 1969, p. 108.

DO NOT WRITE ON THIS SHEET

LAP 10

Student ____________________

Date ____________________

FORCING EASTER LILIES

Instructor's Final Checklist

Check the student's performance in the following elements of forcing Easter lilies.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. Potting date was 115-120 days prior to Easter	[ ]	[ ]	[ ]	[ ]
2. Photoperiod treatment started at 15 inches (38.1) of growth	[ ]	[ ]	[ ]	[ ]
3. Temperature held at 60 degrees F (15.6 degrees C) except during first two weeks and last two weeks	[ ]	[ ]	[ ]	[ ]
4. Student correctly adjusted photoperiod treatment and temperature to obtain height control.	[ ]	[ ]	[ ]	[ ]

Learning Activity Package No. 11

GREENHOUSE PRODUCTION

SPRING SEQUENCE

SELECTING BEDDING PLANT CROPS AND VARIETIES

Ornamental Horticulture

INTRODUCTION

One of the most important decisions to be made by a grower of bedding plants is that of selecting the crops to be grown. Many factors must be considered in making this decision.

This package contains some information and activities which will help you identify factors to consider in making decisions about the selection of a crop.

DIRECTIONS

Read the objective. If you think that you are already able to perform this task, read the Check-Out Activity. Then, either arrange with your instructor about doing the Check-Out Activity,

or

If you need further preparation in order to do the tasks, go through the Learning Activities.

OBJECTIVE

When given a selection of bedding plant crops and varieties, select those crops and varieties most profitably grown in the local area.

LEARNING ACTIVITIES

1 READ one of the following references:

Bedding Plants, Mastalerz, J.W., pp. 5-8.

Greenhouse Flowers and Bedding Plants, Williams, G.S., pp. 257-260.

The Ball Red Book, George J. Ball Inc., pp. 295-297, 285-286.

2 READ *Selecting Bedding Plant Crop Varieties.*

3 CHECK your knowledge by taking the STUDENT SELF-CHECK *Selecting Bedding Crop Varieties.*

4 FILL IN the BEDDING PLANT SELECTION CHART provided in this Learning Activity Package.

5 USE the suggested INTERVIEW GUIDE found in this Learning Activity Package, if feasible.

6 ARRANGE with your instructor to complete this package by going through the CHECK-OUT ACTIVITIES.

TOOLS AND EQUIPMENT

None

MATERIALS AND SUPPLIES NEEDED

None

SAFETY

Not applicable

INSTRUCTIONS

SELECTING BEDDING PLANT CROPS AND VARIETIES

1. What are the major bedding plant crops grown in South Carolina?

   Petunias, marigolds and salvia are the most widely grown bedding plant crops grown for retail sale.

   Other bedding plant crops frequently grown for sale in South Carolina are as follows:

   Ageratem
   Impatiens
   Begonia
   Geraniums
   Zinnias
   Alyssum
   Snapdragons
   Pansy
   Dainthus

2. What factors should be considered in selecting a bedding plant crop for commercial production?

   Since all of the major bedding plant crops require about the same amount of labor and the same types of growing facilities, there is little difference in the cost of producing various bedding plant crops. Also, all of the major bedding plant crops are adaptable to growing conditions in South Carolina. Therefore, the major factor to consider in selecting a crop for commercial production is the demand for the various crops. The leading crops grown in South Carolina were discussed in the preceding section. Since petunias are by far the most popular crop grown and marigolds and salvia are also frequently grown, a typical grower might plant 1/2 of his crop to petunias 1/4 to marigolds and 1/4 to salvia.

Figure 1. Petunias

Figure 2. Marigolds

Figure 3. Salvia

3. Where can one find information concerning the demand for various bedding plant crops?

   Your local county agricultural extension agent provides an excellent source of information concerning the local demand for various bedding plant crops. Other sources include local growers or commercial seed companies.

4. What major characteristics of a bedding plant will the customer look for?

   The customer will probably be considering one or more of the following:

   1. color (the customer will probably want a variety of color)
   2. shade tolerance (can the plant be grown in shade)
   3. height (the customer may want a variety of heights for various landscape effects)
   4. use (some customers will want to use the plants in hanging baskets, as cut flowers, or as dried flowers)

   You may wish to use the chart provided with this learning activity package to record the characteristics of the major bedding plant crops considered. See Chart I, p. 11 – 4.

SUGGESTED INTERVIEW GUIDE

Questions to ask local greenhouse grower:

1. Which bedding plants have you found to be most profitable for spring sales?
2. What is your estimate of:
   a. the cost of producing a dozen bedding plants?
   b. the wholesale price you will receive per dozen?
   c. the total number plants you will sell?
3. What bedding plant crops seem to be most in demand in this area?
4. If you were a beginning grower, what bedding plant crops would you grow?

STUDENT SELF-CHECK

DO NOT WRITE ON THIS SHEET

SELECTING BEDDING CROP VARIETIES

1. Which of the following is not ordinarily considered a bedding plant crop?
   a. salvia (scarlet sage)
   b. petunias
   c. poinsettias
   d. marigolds
   e. pansies
2. List the top three bedding plant crops grown in South Carolina for retail sales.
3. Which of the following factors is most critical for selecting a bedding plant crop to be produced and sold?
   a. demand
   b. adaptability
   c. cost of production
   d. availability of labor

Compare your answers with the correct responses at the bottom of this page. Review any incorrect responses before going on to the next learning activity.

CHECK-OUT ACTIVITIES

In order to finish this learning activity package, you must be able to complete the task(s) listed below. As you go through each activity, your instructor will rate your performance using the Instructor's Final Checklist.

Select those crops and varieties most profitably grown in the local area.

CORRECT RESPONSES

1. c
2. petunias, marigolds and salvia
3. a

CHART I

BEDDING PLANT SELECTION CHART

		COLORS										SHADE				HEIGHT					USES				
CROP		White	Yellow	Orange	Red	Blue	Purple	Pink	Multicolor			Full Sun	Partial Shade			6–12"	1–2'	2–3'	Over 3'		Cut Flowers	Fragrances	Window Boxes	Hanging Baskets	Dried Flowers
PETUNIAS																									
MARIGOLDS																									
SALVIA																									
ZINNIAS																									
OTHER																									

DO NOT WRITE ON THIS SHEET

LAP 11

Student ____________________

Date ____________________

SELECTING BEDDING PLANT CROPS AND VARIETIES

Instructor's Final Checklist

Check the student's performance in the following elements of selecting bedding plant crops and varieties.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. Crops selected were grown by local growers.	☐	☐	☐	☐
2. Varieties selected were among those in demand in the local area in recent years.	☐	☐	☐	☐
3. Crops selected provided the customer with a variety of colors and heights.	☐	☐	☐	☐

Learning Activity Package No. 12

GREENHOUSE PRODUCTION

SPRING SEQUENCE

SELECTING AND PREPARING A GERMINATION MEDIA

Ornamental Horticulture

INTRODUCTION

One of the more important aspects of growing bedding plants is to have a good media in which the seeds are to germinate. Strong, healthy plants are the ones most likely to find a ready market. Such plants need to have a good start from seed. Proper preparation of a germinating media or use of a commercially prepared media is essential for good germination of seed and a good growing start for the young seedlings. In this package, you will learn to select ingredients and prepare a germination media.

DIRECTIONS

Read the objective below. If you think that you are already able to perform these tasks, read the Check-Out Activity. Then, either arrange with your instructor about doing the Check-Out Activity.

or,

If you need further preparation in order to do the tasks, go through the Learning Activities.

OBJECTIVE

Select and prepare, in accordance with industry standards, a recommended media for a seed flat in which bedding plants are to be germinated.

LEARNING ACTIVITIES

1 READ the following: *Greenhouse Crop Production*, The Pennsylvania State University, pp. 39-43; *The Ball Red Book*, George J. Ball, Inc., p. 5; *Greenhouse Flowers and Bedding Plants*, G.S. Williams, p. 211.

2 READ the Instructions, *A–SELECTING AND PREPARING A GERMINATION MEDIUM.*

3 READ the Instructions, *B–PROCEDURE FOR PREPARING A GERMINATION FLAT.*

4 READ the Instructions, *C–PROCEDURE FOR PREPARING A GERMINATION MEDIUM.*

5 CHECK YOUR KNOWLEDGE by taking the Student Self-Check.

6 ARRANGE with your instructor to complete this learning activity package by going through the Check-Out Activity.

TOOLS AND EQUIPMENT

1. Soil Mixer (or concrete mixer)
2. Shovels
3. Screens

MATERIALS AND SUPPLIES

1. Sterilized Soil
2. Peat
3. Perlite, vermiculite or sand

SAFETY

Shovels can get caught in mixer if mixer is in motion when loading.

INSTRUCTIONS

A– SELECTING AND PREPARING A GERMINATION MEDIUM

1. What ingredients are generally used?

   Various mixes of peat, vermiculite, soil and perlite can be used. Commercial ready-prepared mixes are available which have definite advantages.

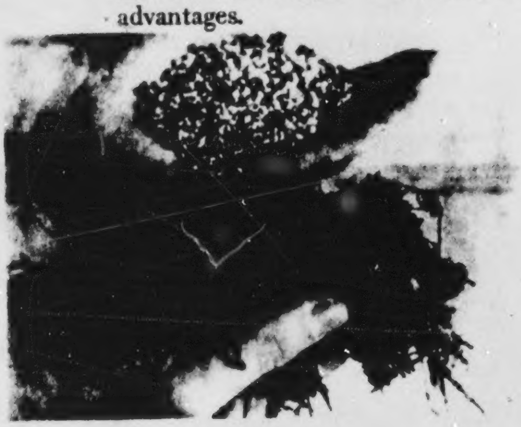


Figure 1. Two commonly used media ingredients – vermiculite and spaghnum moss.

2. What proportion of the ingredients are used?

   Usually a 1-1-1 mixture is used–
   1 part sterilized soil
   1 part peat
   1 part vermiculite, perlite or sand

   Note: Heavy soils should have equal parts sand mixed with it before the other ingredients are added.

3. What are the characteristics of a good bedding plant germination media?

   The media should be light, finely textured, well drained, low in fertilizer and free of weed seed. The media should be sterile.

4. What sources are available that describe the preparation of a recommended media?

   Some of the most widely used sources are as follows:
   The Ball Red Book. Staff of George Ball, Inc.
   Flower and Plant Production. Nelson, K.S., Interstate Printers and Publishers.
   Greenhouse Flowers and Bedding Plants. Williams, G.S., Interstate Printers and Publishers.
   Bedding Plants. Mastalerz, Pennsylvania Flower Growers.

INSTRUCTIONS

B– PROCEDURE FOR PREPARING A GERMINATION FLAT

Flats should be constructed so that they are 2 – 3 inches (approximately 5 - 7.5 cm) deep and small enough to conveniently handle. They should be designed to provide adequate drainage. The soil screenings should be put in the flats. Then, the flats should be filled with soil mixture to within 1/2 inch (approximately 1.25 cm) of the top. The soil at the sides, ends and corners should be tamped to prevent drying or cave-ins. Cover the packed areas with more soil to fill the flat to the top. This keeps the soil level and helps assure even water distribution.

Figure 2. A flat of media ready to be spread. Note that the media should be moist when put in the flats.

INSTRUCTIONS

C – PROCEDURE FOR PREPARING A GERMINATION MEDIUM

1. Determine the quantity of media needed.
2. Determine the mixture to be used—usually 1:1:1 (1 part loamy soil, 1 part peat and 1 part vermiculite)
3. Obtain the ingredients.
    - a. If only a small quantity is to be prepared, a hand scoop or shovel can be used for mixing.
    - b. If a large quantity is to be prepared, a cement mixer may be used.
4. Sterilize media if not already sterile. (See Learning Activity Package No. 22).

STUDENT SELF-CHECK

DO NOT WRITE ON THIS SHEET

SELECTING AND PREPARING A GERMINATION MEDIA FOR BEDDING PLANTS

1. List at least two references related to selecting and preparing a germination media.
2. List at least two characteristics of a good germination media.
3. Name at least one recommended germination media mixture.

Compare your answers with the correct responses on this page. Review any incorrect answers before going on to the next learning activity.

CHECK-OUT ACTIVITY

In order to finish this learning activity package you must be able to complete the task(s) listed below. As you go through each activity, your instructor will rate your performance using the Instructor's Final Checklist.

Select and prepare a recommended media for a seed flat in which bedding plants are to be grown.

CORRECT RESPONSES

1. See page 12 – 1.
2. A good germination media:
    - a. holds moisture
    - b. is well watered
    - c. is sterile
    - d. has good structure (not too tight – not too loose)
3. A commonly used and recommended germination media is as follows:
    1 part sterilized soil
    1 part peat
    1 part perlite, vermiculite, or sand

DO NOT WRITE ON THIS SHEET

LAP 12

Student ____________________

Date ____________________

SELECTING AND PREPARING A GERMINATION MEDIA FOR BEDDING PLANTS

Instructor's Final Checklist

Check the student's performance in the following elements of selecting and preparing a germination media for bedding plants.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. A 1-1-1 mixture including sterilized soil, 1 part peat and 1 part of either vermiculite, perlite or sand was used as the media	☐	☐	☐	☐
2. standard size flats were used	☐	☐	☐	☐
3. coarse material was placed in the bottom of the flat	☐	☐	☐	☐
4. flats were filled to within 1/2 in. (1.27 cm) of the top	☐	☐	☐	☐

Learning Activity Package No. 13

GREENHOUSE PRODUCTION

SPRING SEQUENCE

SEEDING BEDDING PLANTS

Ornamental Horticulture

INTRODUCTION

Actual seeding of the bedding plants is an important phase of bedding plant production. Unless attention is given to the proper seeding practices, poor or no germination may result. The method of seeding can influence such things as air circulation around the young seedlings and the ease of pricking the young seedlings when they are to be transplanted. In this package you will learn how to seed bedding plants.

DIRECTIONS

Read the objective below. If you think that you are already able to perform this task, read the Check-Out Activities. Then either arrange with your instructor about doing the Check-Out Activities,

or

If you need further preparation in order to do the tasks, go through the Learning Activities.

OBJECTIVE

Seed a flat or individual container of bedding plants in a manner that agrees with industry standards.

LEARNING ACTIVITIES

1 READ the following: *Bedding Plants.* Mastalerz, J. W., pp. 55-65.

Greenhouse Crop Production. The Pennsylvania State University, p. 120.

The Time-Life Encyclopedia of Gardening Annuals. Crockett, J.U., pp. 2-3.

2 READ *Seeding Bedding Plants.*

3 READ Procedure, pages 2 and 3.

4 CHECK YOUR KNOWLEDGE by taking the Student Self-Check.

5 STUDY the seeding schedule on page 5.

6 PREPARE a seeding schedule for the bedding plant crops to be grown; similar to the one shown on page 5.

7 OBSERVE another student as he or she satisfactorily performs or is checked out on this package.

8 ARRANGE with your instructor to complete this package by going through the Check-Out Activity.

TOOLS AND EQUIPMENT

Marking Board

MATERIALS AND SUPPLIES

Flats with soil ready for seeding

SAFETY

No special safety precautions necessary.

INSTRUCTIONS

SEEDING BEDDING PLANTS

1. How is the seeding date determined?

   The grower needs to know two things in order to set the seeding date: (1) the total growing time from seeding to sale, and (2) the sales date for the market area.

   The growing time for most bedding plants requires from 2 to 4 months. The growing time varies with the variety difference and growing temperatures. See Seeding Schedule Chart I on page 5.

   Sale dates vary mainly with the frost date for the area. See Chart II on page 6.

2. What is the recommended seeding rate?

   There are no specific recommendations but many growers seed at the rate of 1000-1200 seeds per 11 x 22 in. (28 x 59 cm) flat for smaller seeds and 750-1000 for larger seed.

   The closer the seed are planted the easier it is for diseases to spread. Also plants are more likely to become spindly.

3. What is the recommended planting depth?

   a. As a general rule seeds are planted no deeper than the diameter of the seed.

   b. Small seeded plants such as petunia are planted on the surface.

   c. Some seed require light for germination.

4. What method of seeding is best?

   Although many growers broadcast seed with good results, it is best to plant in rows. The row indentation serves as a collection point for moisture, therefore, seed planted in rows have access to more moisture. Also, rows provide some protection against the spread of disease.

5. Can bedding plants be sown directly into individual containers?

   Yes, however, most growers still germinate seeds in flats and transplant later. Although machines are available for direct seeding in individual containers, the machines are too expensive for smaller growers. Pelleted seeds are sometimes used to make it possible for a seeding machine to handle seeds of varying sizes.

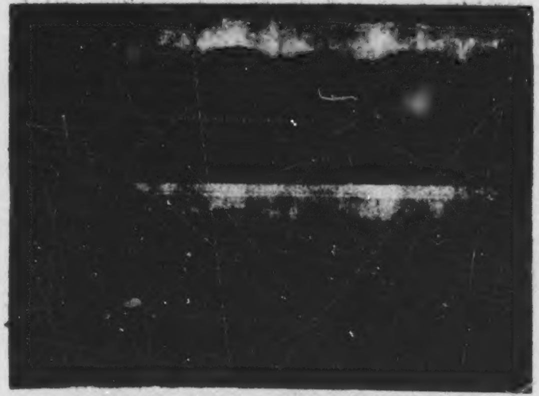


Figure 1. Bedding plants can be germinated and grown in these special containers. The roots of the developing plant penetrate the container. Transplanting to individualized containers at the true leaf stage is not required with this system of production.

PROCEDURE

1. Seeding a Flat
   a. Fill flats with media.
   b. Water the media a day or two before the seed are to be sown.

c. Mark rows. (See figure 2)

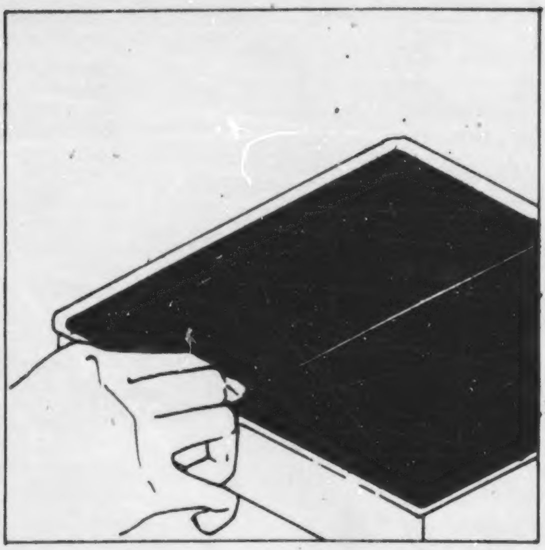


Figure 2. Marking rows.

d. Seed flats. (Note: unless a commercial seeder is available, seed can be placed on a sheet of white paper and carefully dropped into rows, or perhaps shaken directly from the container into rows. Or seed may be mixed with small amount of sterile sand to make planting easier. Cover seed lightly with media. Note: very small seed such as petunia or lobelia, should be left uncovered.)

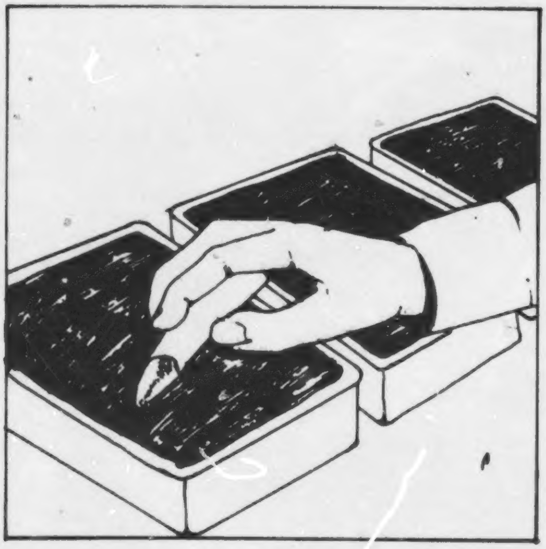


Figure 3. Sowing seed from the seed package.

2. Seeding Individual Containers
   Larger seed may be seeded directly into individual separable containers. Place one or two seeds into the container and cover lightly. (Seeding in individual containers eliminates the job of transplanting the seedlings.)

3. Keeping the Seed Moist
   Keep media moist, using a mist system. If flats are watered by hand, a fog nozzle should be used. The need for watering may be reduced by covering the flat with glass, polyethylene or a damp burlap sheet during the early stage of the germinating period. The covering must be removed as soon as seeds begin to sprout to admit needed light and air.

STUDENT SELF-CHECK

DO NOT WRITE ON THIS SHEET
SEEDING BEDDING PLANTS

1. True or False:
   a. As a general rule bedding plant seeds are planted no deeper than the diameter of the seed. T or F
   b. Very small seed such as petunia or lobelia should be left uncovered. T or F
   c. Some seed require light for germination. T or F
   d. The most commonly used system of producing bedding plants is to seed and grow them in individual containers. T or F
2. What two items of information are necessary in order to select a seeding date?

Compare your answers with the correct responses on the following page. Review any incorrect answers before going on to the next learning activity.

CORRECT RESPONSES

1. a. True
   b. True
   c. True
   d. False
2. a. The total growing time required from seeding to sale
   b. The sales date for the market area

CHECK-OUT ACTIVITY

In order to finish this learning activity package you must be able to complete the task(s) listed below. As you go through each activity, your instructor will rate your performance using the Instructor's Final Checklist.

Using flats previously prepared, seed at least one flat of bedding plants.

CHART I
SEEDING SCHEDULE

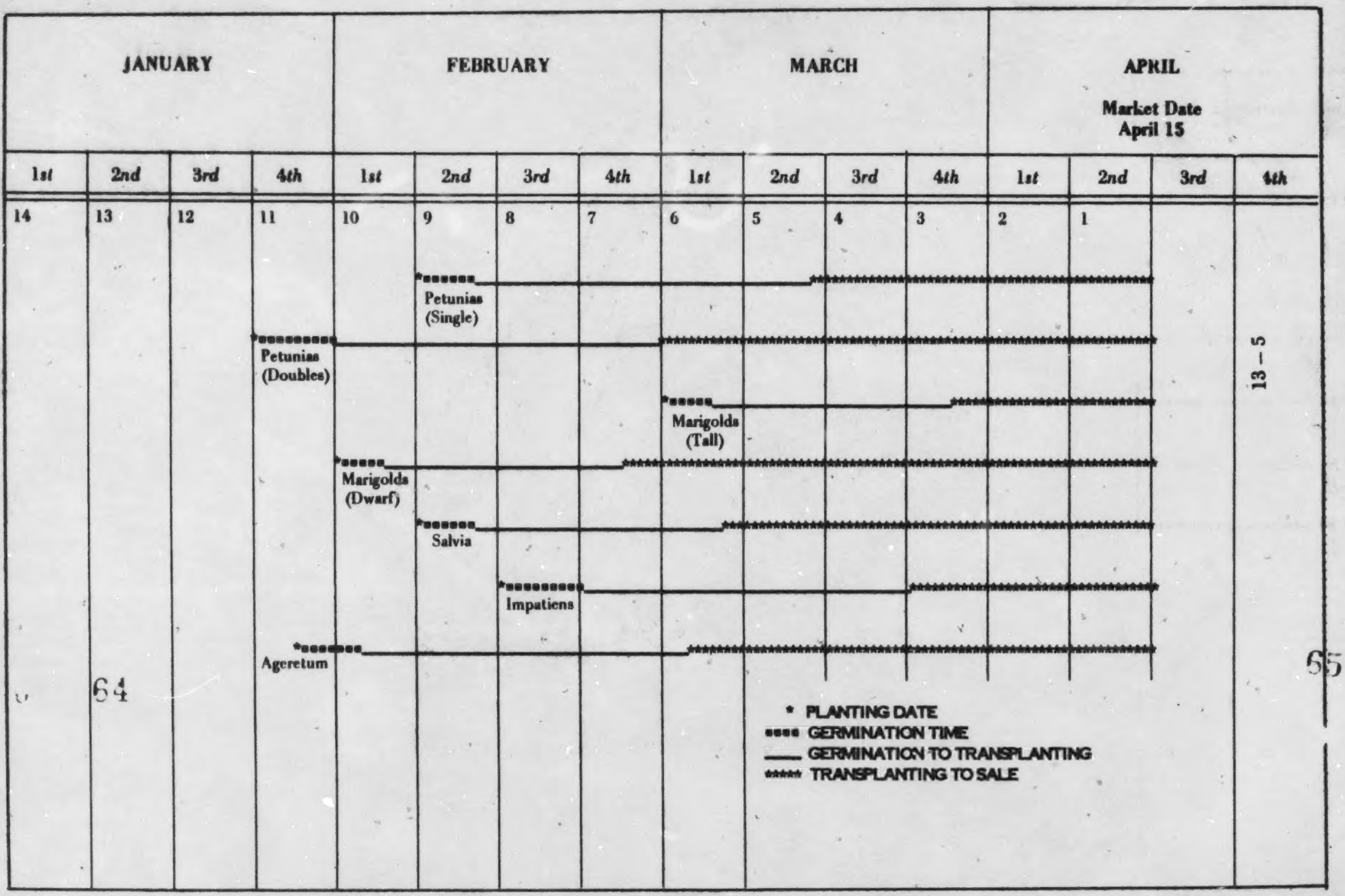
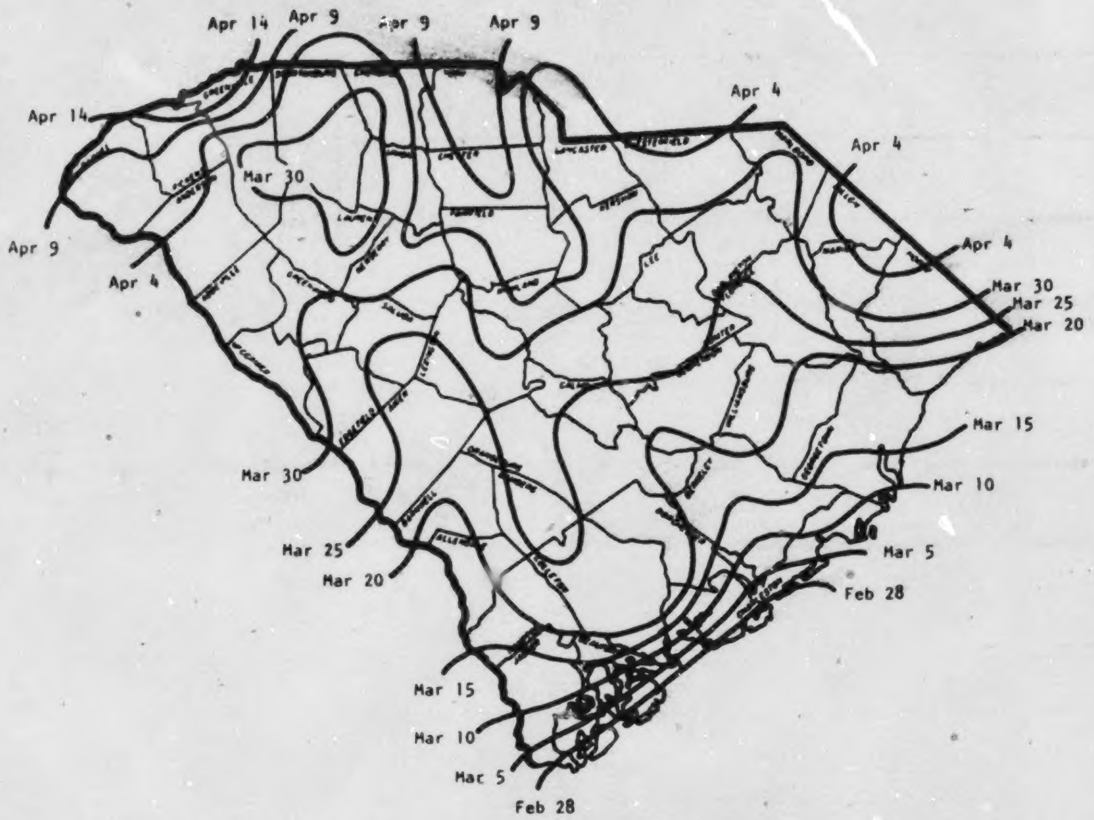


CHART II

The AVERAGE DATE OF THE LAST FREEZE IN THE SPRING


Apr 14
Apr 9
Apr 9
Apr 9
Apr 14
Apr 4
Apr 4
Mar 30
Apr 9
Apr 4
Apr 4
Mar 30
Mar 25
Mar 20
Mar 15
Mar 30
Mar 10
Mar 25
Mar 20
Mar 5
Feb 28
Mar 15
Mar 10
Mac 5
Feb 28

[1] THE PROBABILITIES OF SPRING AND FALL FREEZING TEMPERATURES IN SOUTH CAROLINA November 1975, Bulletin 588. South Carolina Agriculture Experiment Station, Clemson University, Clemson, S.C. p. 25.

DO NOT WRITE ON THIS SHEET

LAP 13

Student ____________________

Date ____________________

SEEDING BEDDING PLANTS

Instructor's Final Checklist

Check the student's performance in the following elements of seeding bedding plants.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
The student:				
1. selected a recommended sales date	☐	☐	☐	☐
2. selected a recommended seeding date for the crop to be grown	☐	☐	☐	☐
3. selected a seeding date for smaller seed of 1000-1200 seeds per flat or 750-1000 seeds for larger seed	☐	☐	☐	☐
4. covered no deeper than the diameter of the seed	☐	☐	☐	☐
5. did not cover very small seeds such as those of petunias or lobelia	☐	☐	☐	☐

Learning Activity Package No. 14

GREENHOUSE PRODUCTION

SPRING SEQUENCE

GERMINATING BEDDING PLANT SEEDS

Ornamental Horticulture

INTRODUCTION

The maintenance of proper environmental conditions during the seed germination process is extremely important. Proper heat, moisture, light and air circulation are all necessary for the seed to germinate and grow to the proper size for transplanting. If these conditions are not as they should be, germination may be slow and erratic, diseases may develop, and growth may be stunted.

Only healthy, fast growing plants with a good appearance find a ready market at a desirable price. In this package, you will learn to provide a recommended environment for bedding plants from the time of seeding to the time of transplanting.

DIRECTIONS

Read the objective below. If you think that you are already able to perform these tasks, read the Check-Out Activities. Then either arrange with your instructor about doing the Check-Out Activities,

or

If you need further preparation in order to do the tasks, go through the Learning Activities.

OBJECTIVE

Plan and maintain a recommended environmental schedule for a selected bedding plant crop from seeding to transplant stage.

LEARNING ACTIVITIES

1 READ one or more of the following:

Bedding Plants. Mastalerz, J. W., pp. 207-208.

Greenhouse Crop Production. The Pennsylvania State University, pp. 122-124.

The Ball Red Book. George T. Ball, Inc., pp. 152-156.

2 READ Germinating Bedding Plant Seed

3 CHECK YOUR KNOWLEDGE by taking the Student Self-Check.

4 ARRANGE with your instructor to complete this Learning Activity Package by going through the Check-Out Activity

TOOLS AND EQUIPMENT

Sprinkler Cans

MATERIALS AND SUPPLIES

None

SAFETY

Not Applicable

INSTRUCTIONS

GERMINATING BEDDING PLANT SEED

1. What temperature is best for germinating bedding plant seed?

   Most bedding plant seeds germinate best at temperatures between 65 and 75 degrees F (Approximately 18 and 24 degrees C). Optimum germination temperatures for specific bedding plants can be found in *The Ball Red Book,* page 155.

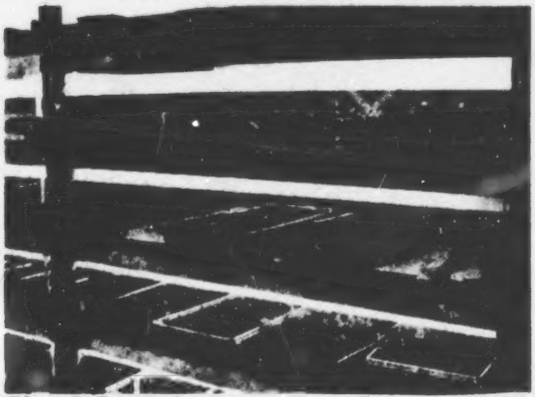


Figure 1. Growth chambers provide excellent environmental control.

2. How can moisture be supplied to the flats?

   For the fastest germination possible, flats must have moisture at all times. There are several ways moisture can be supplied. An automatic mist system provides uniform moisture by intermittent misting (for example, 6 seconds every 10 minutes). Another method involves soaking the flats and wrapping them in polyethelene or burlap after the seeds are sown.

   Caution must be used in order to prevent water from standing in the flats. Watering should be reduced when the seeds have germinated.

Figure 2. The ideal temperature for germinating bedding plants is 70 degrees F (21 degrees C).

3. How can heat for germination be supplied?

   Heat for germination is usually supplied by steam pipes which run under the seed flats. Electric heating pads or cables can also be used to provide bottom heat. If neither of these types of heat are available, most seed can be germinated in most any type of building in which the temperature can be kept at 70 degrees F (21 degrees C) and other environmental conditions necessary for germination controlled.

STUDENT SELF-CHECK

DO NOT WRITE ON THIS SHEET

GERMINATING BEDDING PLANT SEEDS

1. List at least one reference which will provide recommended germination temperatures for bedding plants.

2. If you were asked to pick a range of temperatures for germinating bedding plant seeds, which of the following ranges would you select?

   a. 60-65 degrees F (approximately 16 – 18 degrees C)
   b. 65-75 degrees F (approximately 18 – 24 degrees C)
   c. 75-80 degrees F (approximately 24 – 27 degrees C)

3. Which of the following factors (is, are) most critical for germination?

   a. moisture
   b. light
   c. adequate fertilization

Compare your answers with the correct responses on this page. Review any incorrect answers before going on to the next learning activity.

CORRECT RESPONSES

1. See those listed under LEARNING ACTIVITIES.
2. b
3. a

CHECK-OUT ACTIVITY

In order to finish this learning activity package, you must be able to complete the task(s) listed below. As you go through each activity, your instructor will rate your performance using the Instructor's Final Checklist.

Germinate bedding plant seeds.

DO NOT WRITE ON THIS SHEET

LAP 14

Student ______________________

Date ______________________

GERMINATING BEDDING PLANT SEEDS

Instructor's Final Checklist

Check the student's performance in the following elements of germinating bedding plant seeds.

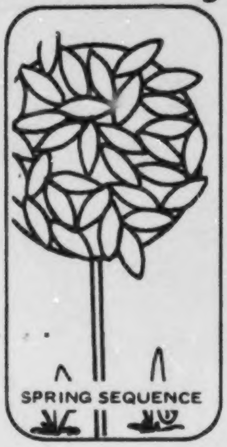
Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. Flats were kept sufficiently moist	☐	☐	☐	☐
2. A temperature of 65-70° F (approximately 18.3-21.1° C) was maintained	☐	☐	☐	☐
3. Seeds were covered or not covered as recommended	☐	☐	☐	☐
4. Circulation was adequate to prevent damping-off	☐	☐	☐	☐
5. Adequate light was provided	☐	☐	☐	☐

Learning Activity Package No. 15

GREENHOUSE
PRODUCTION



TRANSPLANTING BEDDING PLANTS

Ornamental Horticulture

INTRODUCTION

Transplanting seedlings into containers for growing requires more hours of labor than any other single phase of bedding plant production.

Transplanting must be done well and at the proper time if quality plants are to be produced. Proper attention to removal of seedlings from flats and placing them into the growing media will help to assure success in this operation. In this package you will learn how to transplant bedding plants.

DIRECTIONS

Read the objective. If you think that you are already able to perform this task, read the Check-Out Activity. Then either arrange with your instructor about doing the Check-Out Activity,

or

If you need further preparation in order to do the tasks, go through the Learning Activities.

OBJECTIVE

Transplant a selected bedding plant crop in a manner that meets industry standards.

LEARNING ACTIVITIES

1 READ one or more of the following references:

Bedding Plants. Mastalerz, J.W., pp. 85-95.

Greenhouse Crop Production. The Pennsylvania State University, p. 125.

Greenhouse Flowers and Bedding Plants. Williams, G.S., pp. 233-39.

Tips on Growing Bedding Plants. The Ohio State University, p. 5.

2 READ Transplanting Bedding Plants.

3 CHECK YOUR KNOWLEDGE by taking the Student Self-Check.

4 OBSERVE a classmate as he or she transplants a batch of bedding plants.

5 PRACTICE transplanting bedding plants following the instructions given.

6 ARRANGE with your instructor to complete this package by going through the Check-Out Activities.

TOOLS AND EQUIPMENT

Small trowel, dibble or label for transplanting

MATERIALS AND SUPPLIES

Growing media
Seedlings
Growing containers

SAFETY

Not Applicable

INSTRUCTIONS

TRANSPLANTING BEDDING PLANTS

1. When are plants ready to transplant?

   Transplanting bedding plants before they are ready results in a loss of plants. Transplanting too late results in wasted time. The following clues will help you select the point at which plants are ready for transplanting:

   a. When first pair of true leaves appear. (Note: if more than two true leaves have formed, transplanting is more difficult.)
   b. When seedlings are large enough to handle.
   c. When the first pair of true leaves has unfolded.

2. How should plants be transplanted?

   The following procedures should be used in transplanting:
   a. Remove seedling from flat using a small trowel, stick or label.
   b. Hold plant by leaves.
   c. Place plant roots in the containers. (Note: Holding plant by stem may crush or otherwise damage the stem causing death or injury to the young plant.)
   d. Don't pack soil around plantlet. This can break roots. Allow soil to settle naturally when watering.
   e. Plants should be sized-up when transplanting, i.e., those of the same size should be placed in the same container.

3. What type of container is best for growing bedding plants?

   Various types of containers are used for growing bedding plants. They are made in many sizes and shapes and come from various materials – wood, plastic, peat, cellulose fiber, asphalt treated paper and clay. The major difference in types of containers, however, is that some are designed to hold several plants, usually 6, 9, 12, or 24; while others are designed for a single plant (see figure 1). The latest innovation is small pots joined together that can be separated when planting in beds. Some containers can be planted directly into the soil. Roots of the plant grow through the walls of the container. Usually such containers are made of pressed peat.

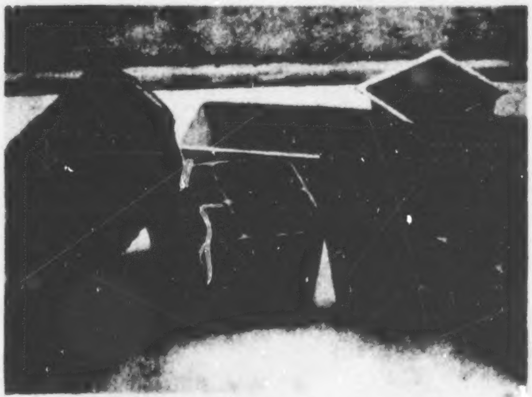


Figure 1. Fiberboard or plastic type container commonly used for marketing bedding plants.

PROCEDURE

TRANSPLANTING BEDDING PLANTS

1. When seedlings are ready to transplant, fill containers with growing media. The same media may be used as was used for germination of seed or a commercial mixture may be used.

2. Make holes for seedling in the media, using a dibble or dibble board.

3. Remove a section of seedlings from the flat, using a label or small trowel and place on potting bench. (Note: the seedling should never be pulled from the flat because this breaks off many of the lateral roots.)

4. Pick up the seedling by the leaves, using the thumb and forefinger and place the roots in the hole in the media. Firm the media gently around the roots, using the thumb and forefinger of both hands. Be sure the plant is planted the same depth in the container as it grew in the flat.

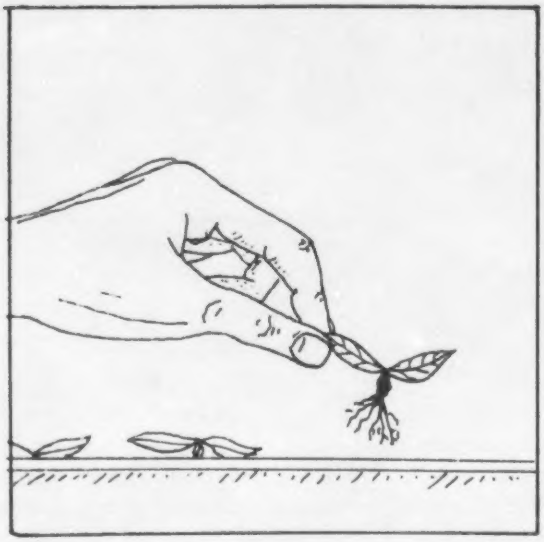


Figure 3. Pick up the seedling by the leaves – not by the stem.

5. Water the transplant. This should be done as quickly as possible to prevent wilting. A watering can with a small spout can be used to settle media around roots or transplants may be placed under a mist system until the media is thoroughly soaked.

Figure 2. Recently transplanted crop ready for growing out.

4. Transplanted seedlings should be watered with:

   a. mist system
   b. watering can with small spout
   c. garden hose with fine nozzle
   d. any of the above

STUDENT SELF-CHECK
DO NOT WRITE ON THIS SHEET
TRANSPLANTING BEDDING PLANTS

1. When removing seedling from a flat:

   a. pull out by leaves
   b. lift out with small trowel
   c. lift out by grasping the stem

2. Seedlings are ready to transplant when they have:

   a. two true leaves
   b. four true leaves
   c. six true leaves

3. When transplanting, seedlings should be picked up by:

   a. leaves
   b. stem

Compare your answers with the correct responses on this page. Review any incorrect answers before going on to the next learning activity.

CORRECT RESPONSES

1. b
2. a
3. a
4. d

CHECK-OUT ACTIVITIES

In order to finish this learning activity package you must be able to complete the task(s) listed below. As you go through each activity, your instructor will rate your performance using the Instructor's Final Checklist.

Transplant bedding plants provided by the instructor.

DO NOT WRITE ON THIS SHEET

LAP 15

Student ______________________________

Date ______________________________

TRANSPLANTING BEDDING PLANTS

Instructor's Final Checklist

Check the student's performance in the following elements of transplanting bedding plants.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. Plantlets were removed from germination flats using small trowel, stick or plant label – not by pulling by the stem or leaves.	☐	☐	☐	☐
2. Student correctly determined when plantlets were ready for transplanting.	☐	☐	☐	☐
3. Student used a dibble or dibble board to form holes for transplanting.	☐	☐	☐	☐
4. Plantlets were watered after transplanting in a manner which settled the soil around the roots.	☐	☐	☐	☐

Learning Activity Package No. 16

GREENHOUSE
PRODUCTION

SPRING SEQUENCE

GROWING-OUT BEDDING PLANTS

Ornamental Horticulture

INTRODUCTION

Maintaining the proper environmental schedule for the newly transplanted bedding plant is an important part of producing a quality plant. Proper temperature, moisture and light control will give us a plant of the right size at the right time.

In this learning activity package you will learn to grow-out bedding plants.

DIRECTIONS

Read the objective. If you think that you are already able to perform this task, read the Check-Out Activity. Then either arrange with your instructor about doing the Check-Out Activity,

or

If you need further preparation in order to do the tasks, go through the Learning Activities.

OBJECTIVE

Prepare and implement an environmental schedule (heat, relative humidity, and light) for the selected bedding crop from the transplant stage to the market stage.

LEARNING ACTIVITIES

1 READ one of the following references:

Bedding Plants. Mastalerz, J. W., pp. 209-11.

Greenhouse Crop Production. The Pennsylvania State University, pp. 128-30.

Tips on Growing Bedding Plants. The Ohio State University, pp. 15-25.

2 READ *Growing-Out Bedding Plants.*

3 CHECK YOUR KNOWLEDGE of growing-out bedding plants by completing the Student Self-Check.

4 OBSERVE another student as he or she is checked-out on this task.

5 ARRANGE with your instructor to complete this package by going through the Check-Out Activity.

TOOLS, EQUIPMENT OR FACILITIES

Access to a typical greenhouse with misting system

MATERIALS AND SUPPLIES

1. Fertilizer of the recommended analysis – usually 20-20-20
2. A sprinkler can

SAFETY

Not Applicable

INSTRUCTIONS

GROWING OUT BEDDING PLANTS

1. Selecting a Temperature Range

   A temperature between 40-60 degrees F (approximately 4 – 16 degrees C) is needed to grow the plants from seedling to market size. The higher the temperature the faster the growth. A temperature of 60 degrees F (approximately 16 degrees C) should be maintained for the first 4 to 5 weeks after transplanting. The temperature should then be gradually lowered to 45-50 degrees F (7-10 degrees C) during the remainder of the growth period. This enables the grower to adjust the rate of growth and also allows for "hardening" the plant which results in harder leaves, darker flowers and a plant which is better able to withstand outside growing conditions. Full sunlight is needed for bedding plants. (See reference for recommended growing temperatures for specific crops.)

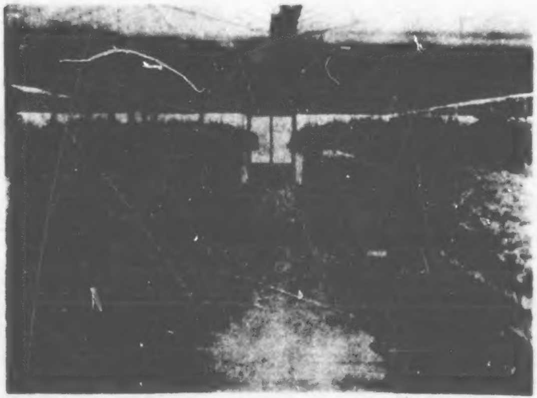


Figure 1. A typical greenhouse bench arrangement. Note the cheese cloth shading.

2. Watering the Plants
   a. A mist system with a time clock is probably the least time consuming. The clock can be set so as to water the plants at the same time every day.
   b. A mist system manually operated works well. However, someone must be present to operate the controls.
   c. A garden hose with some kind of breaker nozzle may be used satisfactorily after the plants have reached a larger size. A watering stick attached to a hose makes it possible to water a bench of plants on the opposite side of the greenhouse from where the operator is standing. (Note: Care must be exercised to see that plants are not knocked over when this system is used.)

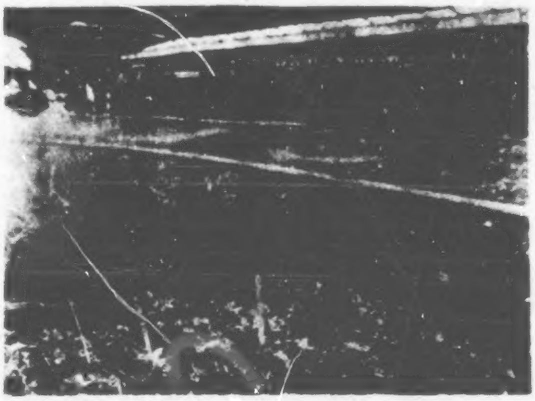


Figure 2. Overhead mist system in operation.

3. Fertilization Procedure

   Fertilize bedding plants with a 20-20-20 formula. Mix 2 ounces (57 g) of 20-20-20 fertilizer in 2-1/2 gallons (9.5 liters) of water. Apply the solution directly to the plants using a sprinkler can. The solution should be applied each week at the rate of a normal watering.

4. Growth Control Procedures

   Growth may be controlled by adjusting the day length and/or spraying with chemicals. However, such measures are not usually necessary on most bedding plant crops (mostly petunia or chrysanthemum). Should you anticipate a need for such measures, see *Greenhouse Flowers and Bedding Plants*, pp. 241-249.

STUDENT SELF-CHECK
DO NOT WRITE ON THIS SHEET
GROWING OUT BEDDING PLANTS

1. Which of the following watering systems (is, are) most consistent and least time consuming?
   a. Hand sprinkling
   b. Hand hosing
   c. Sprinkler system
   d. Automatic mist system

2. How much sunlight is needed for growing bedding plants?
   a. Limited sunlight
   b. Full sunlight

3. What temperature range produces best quality plants?
   a. 70-80 degrees F (21 – 27 degrees C)
   b. 32-40 degrees F (0 – 4 degrees C)
   c. 40-60 degrees F (4 – 15 degrees C)

Compare your answers with the correct responses on this page. Review any incorrect answers before going on to the next learning activity.

CORRECT RESPONSES

1. d
2. b
3. c

CHECK-OUT ACTIVITY

In order to finish this learning activity package you must be able to complete the task(s) listed below. As you go through each activity, your instructor will rate your performance using the Instructor's Final Checklist.

Grow-out a batch of bedding plants provided by the instructor.

DO NOT WRITE ON THIS SHEET

LAP 16

Student ______________________

Date ______________________

GROWING-OUT BEDDING PLANTS

Instructor's Final Checklist

Check the student's performance in the following elements of growing-out bedding plants.

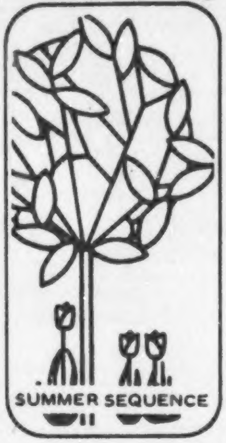
Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. Temperature set at 60° F (16° C) for the first 4 to 5 weeks.	☐	☐	☐	☐
2. Temperature gradually lowered after the first 4 to 5 weeks to 45-50° F (approximately 7 –10° C).	☐	☐	☐	☐
3. Plants were fertilized using a 20-20-20 formula.	☐	☐	☐	☐
4. The 20-20-20 fertilizer solution consisted of 2 ounces (57 g) of the fertilizer per 2½ gallons (9.50 l) of water, and was applied weekly at the rate of a normal watering.	☐	☐	☐	☐

Learning Activity Package No.17

GREENHOUSE
PRODUCTION



SELECTING CROPS TO BE PROPAGATED AND GROWN

Ornamental Horticulture

INTRODUCTION

To make a profit from growing nursery plants, the nursery operator must grow those varieties which will be in demand by the customers. Geographical considerations of climate and soil will also limit where many species will grow successfully.

This packet will help you in selecting the varieties of ornamental shrubs to propagate and grow in your locality.

DIRECTIONS

Read the objective below. If you think that you are already able to perform these tasks, read the Check-Out Activities. Then, either arrange with your instructor about doing the Check-Out Activities,

or

If you need further preparation in order to do the tasks, go through the Learning Activities.

OBJECTIVE

Given an opportunity to interview local nursery operators, select crops to be propagated. The crops selected should meet the criteria discussed in this learning activity package.

LEARNING ACTIVITIES

1 READ one or more of the following:

Nursery Crops and Landscape Design. Williams, G.S., pp. 151-69.

Landscaping the Home and School Grounds. South Carolina Department of Education, p. 23.

2 INTERVIEW a local nursery operator. Use the SUGGESTED INTERVIEW GUIDE.

3 READ *"Things to Consider When Selecting a Nursery Crop,"* p. 2.

4 READ "Major Nursery Crops Grown by South Carolina Nursery Operators," p. 2.

5 CHECK YOUR KNOWLEDGE by taking the Student Self-Check.

6 ARRANGE with your instructor to complete this learning activity package by going through the Check-Out Activities.

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TOOLS AND EQUIPMENT

None

SUPPLIES AND MATERIALS

None

SAFETY

Not Applicable

INSTRUCTIONS

Things to Consider When Selecting a Nursery Crop

1. There are a large number of desirable ornamental plants from which you can select those to propagate and grow. After talking to local nursery operators and also observing plants used in local landscape jobs, you should be able to narrow your choice to perhaps eight to ten varieties. It would not be practical to try to grow too many different kinds of plants, at least until some experience has been gained.

2. Sometimes specialization is good. However, do you think it might be over-specialization to grow only one or two varieties? Would a larger number of varieties lessen the risk of a crop failure? Would more varieties help in finding markets for your plants?

3. You should look up a plant hardiness zone map and locate the hardiness zone in which you live. Also look up in a recommended reference on shrubs a description of the plants you have selected to propagate. Are all of them listed as being hardy in your climatic zone?

4. New varieties of some plants may have been patented. Asexual propagation of patented plants is prohibited except under agreement with the patent owner. Asexual propagation means propagation by any method except by seed. Patented varieties will carry plant patent tags when sold.

5. In your discussions with nursery operators and in studying nursery catalogs do you find that some plants are lower priced than others? Are some species commonly used as sales leaders or relatively large plants offered at low prices? The public will get an image of these as "cheap" plants. Also, some plants may be in over-supply. So, in choosing varieties to propagate you may wish to avoid producing the "cheap" image varieties or those which are seemingly in oversupply. It is generally no more difficult to grow the higher priced and more in demand kinds of plants.

6. You must consider the time of year in planning your propagation program. With the broadleaf species, cuttings are generally made in the late spring and early summer. The broadleaf cuttings will also root in autumn.

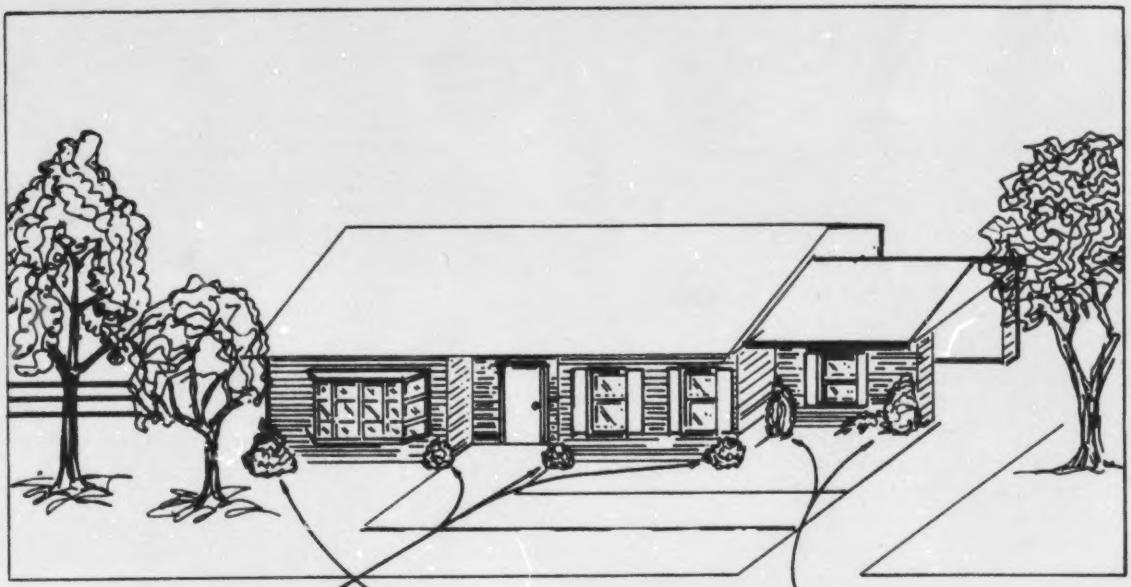
   In rooting conifers it is generally considered that they will root more successfully if cuttings are taken during the winter, after the stock plants have been subjected to frost.

   With deciduous species (those that shed their leaves in the winter), cuttings are usually made in the dormant season. These cuttings are taken in late fall, winter or early spring, when the leaves are off.

SUGGESTED INTERVIEW GUIDE

Questions to ask local nursery operator.

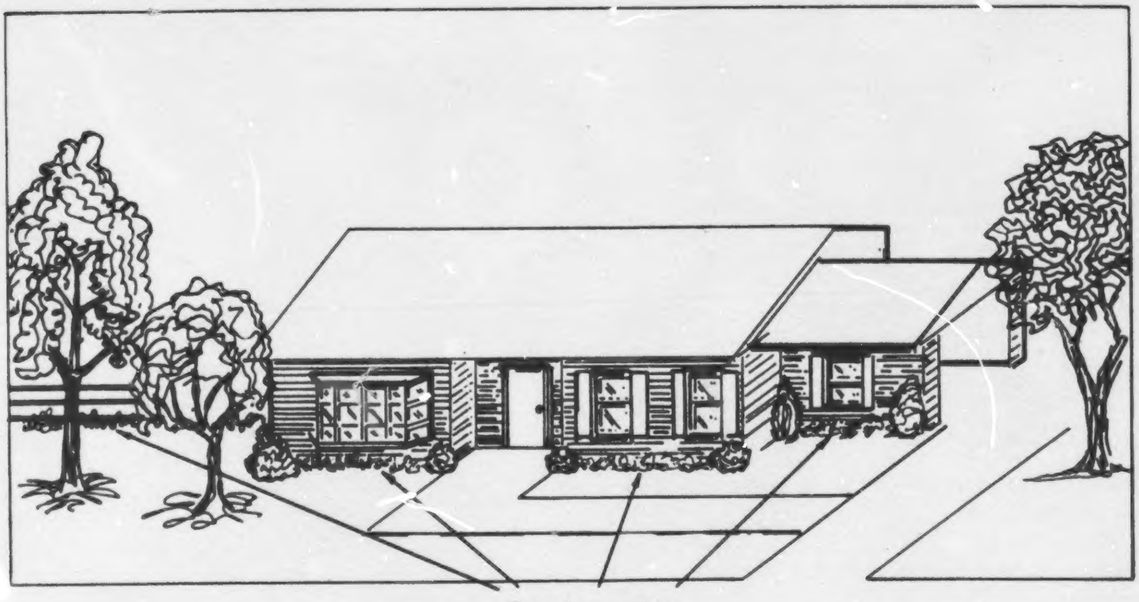
1. Do you propagate any or all of the plants that you sell?
2. a. What are your best-selling shrubs?
   b. What are your best-selling shade and ornamental trees?
3. a. Do you purchase plants from wholesale nurseries located some distance away?
   b. Do you know any reasons why these plants could not be successfully produced locally?



Evergreen shrub (low)
(Heller holly)
(Azaleas)
(Boxwood)

Evergreen shrub (medium)
(Japanese holly)
(Formosa azaleas)
(Rhododendron)

Evergreen shrubs (tall)
(Camellia)
(Burford holly)
(Pyracantha)
(Upright junipers)



Ground cover plants
(English ivy)
(Vinca)
(Santolina)
(Thrift)
(Shore juniper)

Figure 1. Some of the more commonly grown nursery crops as shown in the landscape.

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STUDENT SELF-CHECK

DO NOT WRITE ON THIS SHEET

SELECTING CROPS TO BE PROPAGATED AND GROWN

1. List at least five ornamental shrubs which are listed as major crops grown by South Carolina nursery operators.
2. Can patented plants be propagated asexually and sold?
3. At what time of year are cuttings made of broadleaf evergreen shrubs?
4. At what season are cuttings made of conifers?
5. When are cuttings made of deciduous shrubs?
6. What is meant by "asexual" reproduction of plants?

Compare your answers with the correct responses on this page. Review any incorrect answers before going on to the next learning activity.

CORRECT RESPONSES

1. See chart on page 4
2. No
3. Late spring, early summer
4. Winter
5. Dormant season, late fall, winter or early spring
6. Propagation by any method except seed

CHECK-OUT ACTIVITY

In order to finish this learning activity package you must be able to complete the task(s) listed below. As you go through each activity, your instructor will rate your performance using the Instructor's Final Checklist.

Select a summer crop to be propagated and grown.

MAJOR NURSERY CROPS GROWN BY SOUTH CAROLINA NURSERY OPERATORS

		Ground Cover	Shrubs			Trees	Fruit Trees
			Low	Medium	Tall		
EVERGREENS	BROADLEAF	Thrift Vinca English Ivy Hypericum Ajuga Liriope Phlox Santolina	Heller Holly Azaleas Vomitoria Holly Boxwood Raphiolepis	Japanese Holly Mahonia Barberry Boxwood Nandina Rhododendron	Burford Holly Camellia Pyracantha Cleyera Euonymus Vomitoria Holly Ligustrum Tea Olive Photinia Pittosporum	Loquat Magnolia Oaks – Live Oaks – Laurel	Peach Pecan
	NARROWLEAF	Shore Juniper Blue Rug Juniper Parson Juniper Andorra Juniper Other Junipers	Mugo Pine			White Pine Loblolly Pine	
	DECIDUOUS		Crimson Pigmy Barberry	Flowering Quince Spirea	Crape Myrtle Azalea Cytisod Forsythia	Pin Oak Japanese Magnolia Maple Birch Dogwood Flowering Cherries Flowering Crabapple	

DO NOT WRITE ON THIS SHEET

LAP 17

Student ______________________

Date ______________________

SELECTING CROPS TO BE PROPAGATED AND GROWN

Instructor's Final Checklist

Check the student's performance in the following elements of selecting crops to be propagated and grown.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

Students choice of crops to be grown and propagated followed these guidelines:

		Student Performance			
		Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1.	Student consulted local nursery operators	[ ]	[ ]	[ ]	[ ]
2.	Student studied plant hardiness map to determine which varieties can be grown in the local area	[ ]	[ ]	[ ]	[ ]
3.	Crop chosen was not the cheap variety	[ ]	[ ]	[ ]	[ ]
4.	Student gave consideration to the season in which the crop was to be grown	[ ]	[ ]	[ ]	[ ]

Learning Activity Package No. 18

GREENHOUSE
PRODUCTION

SPRING SEQUENCE

**SELECTING METHODS OF
PROPAGATING
A NURSERY CROP**

Ornamental Horticulture

INTRODUCTION

The grower who plans to produce ornamental plants has a choice of several methods of propagation. Investment in time and money will be greater with some methods. The convenience and the quantity of plants which can be produced will vary under different methods. Therefore, the grower should first study these various factors as they relate to his or her own conditions and then install a system which will be most suitable to these conditions. When you have completed this learning activity package, you should have become familiar with the various methods of plant propagation so you will know which method to use with various species or varieties of plants.

DIRECTIONS

Read the objective below. If you think that you are already able to perform these tasks, read the Check-Out Activities. Then, either arrange with your instructor about doing the Check-Out Activities,

or

If you need further preparation in order to do the tasks, go through the Learning Activities.

OBJECTIVE

Given an opportunity to interview local growers and access to the references listed, select a recommended method of propagating selected horticultural plants.

LEARNING ACTIVITIES

1 READ one or more of the following:

Landscaping the Home and School Grounds. South Carolina State Department of Education, pp. 19-23, and pp. 107-125.

Plant Propagation – Principles and Practices. Hartmann and Kester, pp. 2-3.

2 READ the Instructions, *METHODS OF PROPAGATION.*

3 CHECK your knowledge by taking Student Self-Check.

4 INTERVIEW a local greenhouse grower to find out which methods of propagation he or she uses. A suggested interview guide is included in this package.

5 ARRANGE with your instructor to complete this package by going through the Check-Out Activities.

TOOLS AND EQUIPMENT

None

SUPPLIES AND MATERIALS

None

SAFETY

Not Applicable

INSTRUCTIONS

METHODS OF PROPAGATION

1. Is it difficult to propagate plants by using cuttings?

   With most of the ornamental plants which are used for landscaping, the growing of plants by using cuttings to increase them is not at all difficult. Some plants, such as ivy and aucuba, will even root in a container of water, with practically no care.

   Rooting of cuttings is classed as a method of vegetative propagation of plants. The stems and some other vegetative parts of plants are able to form roots and stems under the right conditions. Your objective is to learn what are the best conditions and how to apply them in order to grow plants from cuttings.

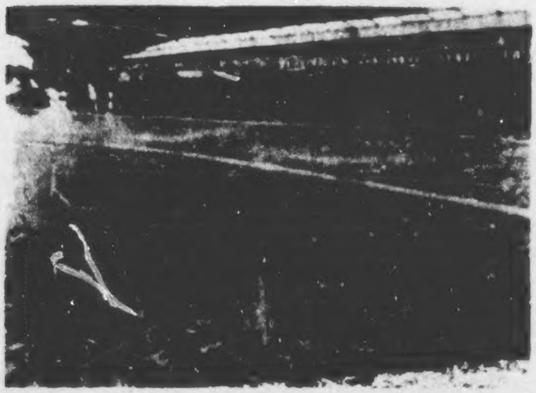

Figure 1. Most nursery crops are propagated by stem cuttings.

An important advantage of growing plants from cuttings is that normally each plant will carry the same characteristics as its parents. This may not be true of plants reproduced from seed for if they are cross-pollinated the seed-grown offspring will carry a mixture of characteristics inherited from both parents.

Hardwood cuttings require no special temperature or humidity controls in order to root. But plants are produced from hardwood cuttings much more slowly than from softwood cuttings. Also, some species of plants will not readily root from hardwood cuttings but will root from softwood cuttings. See Table 1.

Softwood cuttings, made while the wood is soft and actively growing, will usually root quickly and easily if care is taken to prevent the cuttings from drying out during rooting. When the cuttings are first placed in the rooting medium they have no roots to absorb water. If a method is used to keep the cuttings in high humidity there is less lose of water from them and rooting is more satisfactory. Mist systems have been devised which do an excellent job of maintaining proper moisture conditions. Mist systems can be either automatic or non-automatic.

The non-mist system of maintaining a high humidity in rooting cuttings relies on a structure such as a greenhouse, hotbed, coldframe or, on a small scale, propagation boxes covered with polyethelene. Whatever structure is used, the cuttings must be kept well watered and prevented from drying out.

Today, in commercial propagation, there is a widespread use of mist systems in rooting cuttings. Propagation can be carried out in a structure such as a greenhouse, hotbed, or coldframe, but under mist successful rooting can be accomplished in the open. However, in open field rooting, shade may be necessary to prevent too rapid transpiration of moisture during sunny, hot weather.

2. (a) What ornamental plants are best grown from seed?

The use of seed is an important way of propagating plants. Look up now the list of plants which may be grown from seed in *Landscaping the Home and School Grounds,* pages 20-21. You will note that most ornamental trees and some shurbs can be grown from seed. The flowering dogwood, for example, is commonly grown from seed. A disadvantage of growing from seed, however, is that special varieties of dogwood such as pink or red types will not come true to variety from seed. As they are difficult to root from cuttings they are usually propagated by grafting. The root stock, however, may be grown from seed.

(b) Do plants grown from seed produce marketable size plants as fast as plants grown by other methods?

No. Nursery operators have found that where plants can be propagated by either seed or by one of the other methods, the seed-grown plants usually grow off more slowly. Azaleas, for example, can be grown from seed or from cuttings. But azaleas from seed grow so slowly that it takes four years to produce a plant as large as can be grown from a cutting in two years.

In spite of disadvantages in growing some species, propagation from seed is still the quickest way to reproduce many kinds of ornamental plants.

3. Can all ornamental plants be propagated by using either seeds or cuttings?

No. Some plants will not remain true to their parentage when grown from seed, and in addition, cuttings from such plants are sometimes difficult to root.

So, although the majority of plants being grown for ornamentals are propagated by the simpler methods of production, by seeds or cuttings, other methods such as grafting or layerage must sometimes be used.

Grafting or budding is expensive and time consuming. Therefore, layerage is often the more practical method. You should now refer to pages 24-27 of *Landscaping the Home and School Grounds* for descriptions of the four methods of propagation by layering. What are these four methods of layering?

You can understand after reading the above reference that layering is a slow method of increasing plants – that is, the grower cannot produce a very large number of plants in a given time. Another disadvantage of layering is that it takes a lot of space to produce a large number of plants because only a few plants can be produced from each stock plant at any one time.

You should refer to books on plant propagation for lists of species of plants which experience has shown are best propagated by layering.

4. Are some species of ornamentals propagated by the methods of grafting or budding?

Yes, as mentioned earlier, some plants like the pink or red varieties of dogwood are increased by grafting scion wood from trees of known characteristics on stock plants which have been grown from seed. Many camellias are also produced by grafting. Almost all commercially grown rose bushes are produced by budding. The commercial production of roses is highly specialized and is limited to a few growing areas in the United States.

The production of grafted or budded ornamental plants is limited to only a few species and to a rather limited number of growers.

SUGGESTED INTERVIEW GUIDE

By questioning the operators and from your own observations at local nurseries, be able to answer the following:

1. What plant propagation methods are used?
2. What type of structure or structures are used for plant propagation?
3. What method is used to maintain a high humidity in growing plants?

4. What is the source of water for producing plants?

5. Is a supply of trained labor available?

STUDENT SELF-CHECK

DO NOT WRITE ON THIS SHEET

METHODS OF PROPAGATION

1. List five methods of propagating plants.

2. Which will usually produce plants more quickly, hardwood cuttings or softwood cuttings?

3. Why are certain plants which produce viable seed, such as the pink dogwood, not propagated from seed?

4. What is one disadvantage of layering as a method of propagation?

5. Does it cost less to produce plants by cuttings or by grafting and budding?

Compare your answers with the correct responses on this page. Review any incorrect answers before going on to the next learning activity.

CORRECT RESPONSES

1. Five methods of propagating plants are:

   (a) Seed
   (b) Cuttings
   (c) Layering
   (d) Grafting
   (e) Budding

   Other methods sometimes used are by:
   (f) Division and(g) Separation

2. Softwood cuttings, when they can be used, root much faster than hardwood cuttings.

3. It is not satisfactory to grow some plants from seed because they do not come true to the variety.

4. Layering as a method of propagation is slower than reproduction from seed or cuttings. It requires more space to produce a given number of plants and the number that can be obtained from each stock plant at any one time is small.

5. Producing a plant from a cutting generally costs less than the production of a plant by grafting or budding. There is much more labor and often a longer period of time is required in the latter.

CHECK-OUT ACTIVITY

In order to finish this learning activity package you must be able to complete the task(s) listed below. As you go through each activity, your instructor will rate your performance using the Instructor's Final Checklist.

Select a recommended method of propagating a nursery crop.

TABLE 1. PROPAGATION METHODS FOR SELECTED ORNAMENTAL SHRUBS[1]

Name	Method	Wood	Time	Remarks
Azalea (Azalea "Indica")	Cuttings	Softwood	July thru Aug.	
Chinese Holly (Ilex Cornuta)	Cuttings	Softwood or hardwood	July thru Aug. late Nov. thru mid-March	Some varieties may require wounding and application of a hormone.
Photinia (Photinia "Fraseri")	Cuttings	Softwood	July thru Aug.	
Pittosporum (Pittosporum Tobia)	Cuttings	Softwood	July thru Aug.	
Formosa Firethorn (Pyracantha)	Cuttings and seeds	Semi-hardened	Sept. thru Oct.	Seed may be the fastest way to produce a large volume.
Abelia (Abelia Grandiflora)	Cuttings and layering	Softwood or hardwood	July thru mid-Oct., early spring	
Boxwood (Buxus)	Cuttings	Softwood or hardwood	Spring and fall	
Japanese Holly (Ilex Crenata)	Cuttings	Softwood or hardwood	July thru Aug., Nov., thru mid-March	
Pfitzer Juniper (Juniperus chinensis pfitzeriana)	Cuttings	Hardwood	Dec. thru Jan.	Light wound is helpful.
Nandina (Nandina Domestica)	Seed		October	
Hybrid Rhododendron (Many varieties)	Cuttings	Semi-hardened	Mid-Aug. thru Oct.	Rather difficult to root. Wound heavily.
American Holly (Ilex opaca)	Cuttings	Softwood or hardwood	July thru Aug., Sept. thru March	Wound heavily.
Camellia (Camellia japonica)	Cuttings	Semi-hardened	Aug. thru Sept.	Wound
Tea Olive (Osmanthus delavayi)	Cuttings	Softwood	July thru Aug.	

A more complete list of plants along with methods of propagation are given in plant propagation books.

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[1] Vocational Education Media Center, *Landscaping the Home and School Grounds*, Columbia, SC: State Department of Education, 1970.

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DO NOT WRITE ON THIS SHEET

LAP 18

Student ______________________

Date ______________________

SELECTING METHODS OF PROPAGATING A NURSERY CROP

Instructor's Final Checklist

Check the student's performance in the following elements of selecting methods of propagating nursery crops.

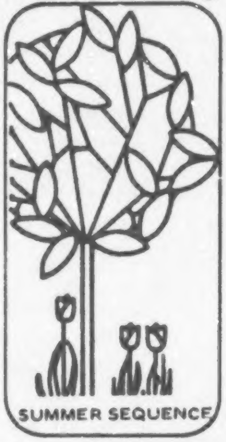
Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. Student conducted interview with a local grower to determine which type of propagation methods are used	[ ]	[ ]	[ ]	[ ]
2. Student selected recommended methods of propagating selected nursery crops	[ ]	[ ]	[ ]	[ ]

Learning Activity Package No. 19

GREENHOUSE PRODUCTION



DETERMINING THE QUANTITY OF PLANTS TO PROPAGATE

Ornamental Horticulture

INTRODUCTION

While deciding on a method of propagating ornamental plants, the nursery operator must at the same time consider the quantity of plants that will be produced. If there is a market for rooted cuttings, the nursery operator may devote all available space and equipment to producing only rooted cuttings, called "liners". But most nursery operators will prefer to transplant their liners to containers or to nursery rows in the field to be grown out for sale. In either case, the available space, financing, and labor must be considered in estimating the quantity of plants which can be produced.

In using your school ornamental horticulture plant production facilities, your job will be much simpler than that of a commercial producer. Your primary assignment is to measure the space available for rooting cuttings and then calculate the number of cuttings which can be rooted at one time in this space.

DIRECTIONS

Read the objective below. If you think that you are already able to perform these tasks, read the Check-Out Activities. Then, either arrange with your instructor about doing the Check-Out Activities,

or

If you need further preparation in order to do the tasks, go through the Learning Activities.

OBJECTIVES

Given the references and information provided in this learning activity package the student will be able to list at least three factors to consider in determining the quantity of plants to propagate.

Given the dimensions of a propagation bed, the row spacing and in row spacing to be used, and the size of plant to be rooted (large or small) calculate the total number of cuttings needed.

LEARNING ACTIVITIES

1 READ the following reference:

Landscaping the Home and School Grounds, South Carolina Department of Education, p. 22.

or

2 READ the Instructions, *Determining the Quantity of Plants to Propagate.*

3 CHECK YOUR KNOWLEDGE by taking the Student Self-Check.

4 USE the Instructional Charts provided for calculating space and determining the number of cuttings to be placed, pp. 3 and 4.

5 ARRANGE with your instructor to complete this package by going through the Check-Out Activities.

TOOLS AND EQUIPMENT

None

MATERIALS AND SUPPLIES

None

SAFETY

Not Applicable

INSTRUCTIONS

A – ESTIMATING DEMAND

1. In determining the quantity as well as the varieties of plants to grow, should the nursery operator be concerned with where the plants are to be sold?

   The commercial grower of ornamental shrubbery, especially when first getting into the business, must thoroughly study the market situation. If the grower plans to wholesale plants, he should visit retail outlets in advance and endeavor to learn the numbers, sizes, and kinds of plants that they sell. In producing plants to sell wholesale, the grower will probably limit to a rather small number the varieties of plants which he will propagate. If the grower plans to retail most of the plants which he will produce, he may grow a larger number of varieties. In either case, the nursery operator must be concerned with prospective markets and make estimates on the number of plants that the markets will absorb.

2. Demand for the crop will undoubtedly be the major factor considered in determining the quantity of plants to be produced, but other factors must also be considered:

   a. Growing Area Under Glass or Plastic. Although most propagation is done in the summer months, some propagation must be done under cover.

   b. Growing Area Under Shade. Shade is a necessity for growing many nursery crops, especially azaleas, camellias and some hollies.

   c. Labor Supply. Large quantities of labor are needed, much of it seasonally and for short periods only. This kind of labor is sometimes difficult to find. Cuttings must be taken from stock plants, kept moist and propagated in beds. Workers must be trained to select cutting material, prepare the cutting and place correctly. Skill is also required in transplanting and in potting.

   d. Capital. The major investment is land, but irrigation equipment and propagation structures also require some capital. Labor cost and the cost of supplies such as fertilizers and pesticides must also be considered. These latter items, however, are not usually considered capital but cash needs.

B – CALCULATING THE PROPAGATION BED AREA REQUIRED

1. A method of calculating quantities of cuttings which can be propagated using two different spacings for cuttings is shown on page 3 of this package. These spacings vary depending on the size of cuttings and size of leaves on the cuttings. The spacings suggested for making your calculations might be considered as "average" spacings. You may wish to use a different spacing. For example, some nursery operators suggest that cuttings be placed 1-1/2 inches to 2 inches (approximately 3.8 to 5 cm) apart in rows which are approximately 2 inches (approximately 5 cm) apart in flats. Large, leafy cuttings may need more space.

   While spacings may vary according to the species or variety and the propagation system used, in general it is agreed that cuttings should be stuck close enough that the leaves touch but do not overlap.

2. Will the distance between the cuttings in the rooting bed influence the quantity of plants which can be propagated?

   Of course the closer together the cuttings are placed, the more you can get in a rooting bed or flat. But experience has shown that if placed too close, cuttings will tend to rot and if they do root, the root systems will be smaller than if there is sufficient space for each cutting.

3. After selecting a spacing for rooting cuttings, how is the total quantity or number of cuttings that can be rooted in our school facilities determined?

   On page 4 of this package is a sample of a suggested form which can be used to determine the total area available for rooting cuttings. You should copy this form and then fill in the figures which apply to your own school facilities. When you have calculated the total rooting area available, then apply the formula at the bottom of this page. This will give you an estimate of the number of cuttings your space will accommodate.

4. Will all varieties of cuttings take about the same amount of space in the rooting beds?

   No, as discussed in paragraph 2 above, larger stem cuttings or those with larger leaves will occupy more space in the rooting facility. So your final step in completing the requirements of this packet is to assign a certain proportion of the rooting area to each of the varieties from which you have decided to take cuttings. You may plan to make more cuttings from some varieties; and the larger cuttings will require more space. But the total space assigned aii varieties, of course, should not exceed the total of the amount of rooting space available.

5. Can the facilities for rooting cuttings be used to produce more than one crop of liners in a year?

   Yes, some nursery operators will use the same equipment to produce two crops of rooted cuttings during the summer. The same area can be used again in the late fall and winter months for rooting certain coniferous evergreens or for hardwood cuttings of some species. This may not be possible with some slow rooting species.

6. Is ornamental plant production a satisfactory enterprise or "project" for vocational agriculture students?

   A number of students in agriculture courses have undertaken the production of an ornamental horticulture crop as a home project. Plants produced are used in landscaping the home or sold. This can be an interesting and profitable enterprise.

   If you wish to plan the production of ornamental shrubs as a home enterprise, you should now make an estimate of the quantity of plants for which you can provide facilities.

INSTRUCTIONAL CHART

CALCULATING NUMBER OF CUTTINGS FOR SPACE AVAILABLE

Figure rows of cuttings in propagating flats or beds at 2 inches (approx. 5 cm) apart. Distance between cuttings in the row can be estimated as averaging 2 in. (approx. 5 cm) apart for larger cuttings and 1 in. (2.5 cm) apart for smaller cuttings. This amounts to 4 sq. in. (approx. 25.8 sq. cm) of space per cutting for larger cuttings and 2 sq. in. (approx. 12.9 sq. cm) of space for small cuttings. Then calculate as follows:

Total sq. inches (cms) space (___) ÷ 4 = ___number of large cuttings

Total sq. inches (cms) of space (__) ÷ 2 = ____number of small cuttings

INSTRUCTIONAL CHART

CALCULATING SPACE AVAILABLE FOR ROOTING CUTTINGS

SYSTEM	Dimensions in Inches Width (A) Length (B)	Square Inches of Area (A) % (B)		Total Sq. In. (Sq. cm) of area
		Under Mist	Non-Mist	
Greenhouse Bench Space				
Hotbeds w/ Electric Heat Cable				
Cold frames				
Propagation Boxes w/Polyethelene covers		XXX		
Open Area w/Mist System			XXX	
	Grand Total (Square Inches)			

STUDENT SELF-CHECK
DO NOT WRITE ON THIS SHEET
DETERMINING THE QUANTITY OF PLANTS TO PROPAGATE

1. In plant propagation, what is a "liner"?

2. List two types of structures which are used in rooting cuttings.

3. What is an average spacing between the rows of cuttings in rooting beds?

4. For small cuttings, what is an average spacing between cuttings within the row?

5. In rooting beds, should cuttings be placed close enough that the leaves overlap?

6. List at least three factors to consider when determining the number of plants to be propagated.

7. Calculate the number of large plant cuttings needed to fill a propagation bed 2½ ft. x 5 ft. (.8 - 1.5 m).

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next learning activity.

CHECK-OUT ACTIVITY

In order to finish this learning activity package you must be able to complete the task(s) listed below. As you go through each activity, your instructor will rate your performance using the Instructor's Final Checklist.

Determine the quantity of plants to be propagated.

CORRECT RESPONSES

1. In plant propagation a "liner" is a rooted cutting, ready to be "lined out" in a field growing unit or to transfer to a container to be grown out.

2. Structures used in rooting cuttings include: (a) Greenhouses, (b) Hotbeds (c) Cold frames (d) Shade houses.

3. Two inches between rows of cuttings might be considered an average spacing.

4. An average spacing within the row for smaller cuttings is about 1 inch.

5. No, leaves may touch but should not overlap to any extent in the rooting bed.

6. Demand
   Available facilities and equipment
   Available labor
   Available capital

7. 450 plants

DO NOT WRITE ON THIS SHEET

LAP 19

Student ______________________________

Date ______________________________

DETERMINING THE QUANTITY OF PLANTS TO PROPAGATE

Instructor's Final Checklist

Check the student's performance in the following elements of determining the quantity of plants to propagate.

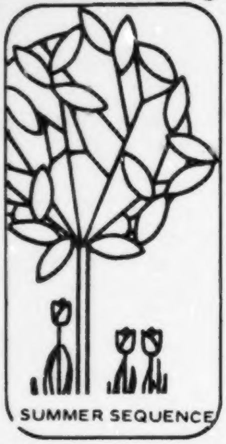
Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. In selecting the quantity of plants to be propagated, student took the following into consideration:				
a. demand for the crop	☐	☐	☐	☐
b. space required for propagating	☐	☐	☐	☐
2. Student used table to correctly determine space requirements	☐	☐	☐	☐

Learning Activity Package No. 20

GREENHOUSE PRODUCTION



PREPARING A SCHEDULE FOR PRODUCING ORNAMENTAL NURSERY PLANTS FROM CUTTINGS

Ornamental Horticulture

INTRODUCTION

The nursery operator, to a large extent, is controlled by the seasons. For success the various operations should be scheduled so they are carried out at the best time. Necessary supplies and equipment must be secured at the proper time so there will be no holdup in the various operations. This activity package is intended to help you in preparing a schedule for producing ornamental nursery plants from cuttings.

DIRECTIONS

Read the objective. If you think that you are already able to perform this task, read the Check-Out Activity. Then either arrange with your instructor about doing the Check-Out Activity,

or

If you need further preparation in order to do the tasks, go through the Learning Activities.

OBJECTIVE

Given the references provided in this learning activity package, prepare a production schedule for a selected nursery crop.

LEARNING ACTIVITIES

1 READ one or more of the following selections:

Landscaping the Home and School Grounds, South Carolina Department of Education, pp. 19-23.

Plant Propagation – Principles and Practices. Hartmann and Kester, chapters 17, 18, and 19. (Use as reference for crops for which a schedule is to be made.)

2 READ the Instructions, *A – Preparing a Schedule for Producing Ornamental Nursery Plants from Cuttings*.

3 READ the Instructions, *B – Preparing a Schedule for Growing an Ornamental Nursery Crop*.

4 CHECK YOUR KNOWLEDGE by taking the Student Self-Check.

5 COMPLETE the task outlined in the Instructions on page 4.

6 ARRANGE with your instructor to complete this package by going through the Check-Out Activity.

TOOLS AND EQUIPMENT

None

MATERIALS AND SUPPLIES

References

INSTRUCTIONS

A–PREPARING A SCHEDULE FOR PRODUCING ORNAMENTAL NURSERY PLANTS FROM CUTTINGS

1. How is a schedule useful in planning to grow nursery plants?

   The nursery operator's schedule is based on the seasons. Some growing operations are critical as to the time or season of the year they are carried out. A schedule helps the grower in seeing that these essential growing operations are carried out before it is too late in the season.

2. Can you plan your plant propagation schedule according to the calendar?

   The calendar is the basis for your planning. But a few critical operations, such as the time of taking cuttings with some plants, must be adjusted to the seasons and weather, not to the month of the year. An early spring with weather warmer than the average over a period of several weeks will, for example, force some plants such as azaleas into early growth which matures early enough to be rooted as much as two or three weeks sooner than usual.

3. Can all species of plants be rooted at the same season or time of year, if average weather prevails?

   No, plant species differ in their rate of growth and in their requirements as to the season and stage of growth when they will root best. This is one of the main reasons for preparing a propagation schedule. With this schedule, you can time the production of different ornamental plants to the seasons when they will do best. You can, if necessary, then adjust your schedule to unusual seasonal weather conditions.

4. How is the season at which cuttings are transplanted related to the season when they are started in the rooting bed?

   Various varieties may require different lengths of time to root. Here a schedule can also help you. This schedule can be based on the average lengths of time it takes the different varieties to root. Combined into one, the schedule can indicate both approximately when to start cuttings in the rooting bed and when they should be ready to transplant. The grower can then secure necessary supplies and equipment in advance and program his propagating methods for best results.

5. Do reference books on plant propagation give schedules for propagating various plants?

   Yes, there are numerous very good references on this subject. You will find some of them, however, are based on climatic and weather conditions from other parts of the country which must be adapted to your local environment. The experience of others is a good starting place in making up your own schedule. In talking to local nursery operators you might gain the benefits of their findings. You should make up your own schedule taking your own local conditions into consideration plus using the findings based on past experience of others. Chapters 17, 18, and 19 of *Plant Propagation – Principles and Practices* give summary information about propagating the crops grown by nursery operators. Use this source only as a reference.

6. What information should go on my schedule in addition to the time to root cuttings and the time to transplant them?

   These are the only two seasonal items. Other operations are based on the scheduling of these. But your schedule can be more useful if you will add, under "remarks", information on such practices as the following:

   (a) Wounding, if needed

   (b) Length of cuttings

   (c) Spacing of cuttings

   (d) Rooting medium, if different

SCHEDULE FOR ROOTING AND TRANSPLANTING CUTTINGS

Species	Type of Wood	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Remarks
Azalea	Softwood	R T	T	T							R	R	R	
Camellia	Semi-hardwood	R	T	T			T	T					R	W
Pfitzer Juniper	Hardwood			T(a)	R	R			T					W

R – indicates seasons for starting cuttings.
T – indicates when to transplant rooted cuttings to containers or field.
T (a) – some slow or difficult to root species may not be ready to transplant until as long as a year after they are started
W – wounding helpful

(e) Rooting hormone, if different

(f) Other

INSTRUCTIONS

B–PREPARING A SCHEDULE FOR GROWING AN ORNAMENTAL NURSERY CROP

In this package, page 3, you will find a sample form for a schedule. On the sample form three representative ornamental plants have been scheduled for time of rooting and the estimated time of transplanting after cuttings have rooted. The propagation times in this sample chart are based on recommendations in Table 2, page 23, of your reference *Landscaping the Home and School Grounds.*

Prepare for yourself a form similar to the sample on page 3. Then complete the form for those species of plants which you have decided to propagate from cuttings.

STUDENT SELF-CHECK

DO NOT WRITE ON THIS SHEET

PREPARING A SCHEDULE FOR PRODUCING ORNAMENTAL NURSERY PLANTS FROM CUTTINGS

1. What are the two main production practices scheduled on a plant propagation schedule or calendar?
2. In addition to the two main items or practices on the production schedule, what are two other production practices that the schedule might indicate about various plants?
3. How do seasonal weather conditions affect the use of your plant propagation schedule?
4. Are all plants which require the same method rooted at the same time?
5. Do all plants take about the same length of time in which to root?

Compare your answers with the correct responses on this page. Review any incorrect answers before going on to the next learning activity.

CORRECT RESPONSES

1. The two main production practices scheduled on a plant propagation schedule are:
   (a) Time to root cuttings
   (b) Time to transplant cuttings which have rooted
2. The schedule might also show information on any of the following:
   (a) Wounding
   (b) Length of cuttings
   (c) Spacing of cuttings
   (d) Rooting medium
   (e) Rooting hormone
3. An early spring can advance plant propagation, a late spring can delay it. Also, an early winter can move up the decision on taking hardwood cuttings, a late winter can delay this operation.
4. No, different species may have different rates of growth and also different stages of growth at which they root best.
5. No, different species of plants respond differently to the rooting conditions and some are much slower than others rooting.

CHECK-OUT ACTIVITY

In order to finish this learning activity package you must be able to complete the task(s) listed below. As you go through each activity, your instructor will rate your performance using the Instructor's Final Checklist.

Prepare a schedule for an ornamental nursery crop.

DO NOT WRITE ON THIS SHEET

LAP 20

Student ______________________

Date ______________________

PREPARING A SCHEDULE FOR PRODUCING ORNAMENTAL NURSERY PLANTS FROM CUTTINGS

Instructor's Final Checklist

Check the student's performance in the following elements of preparing a schedule for producing ornamental nursery plants from cuttings.

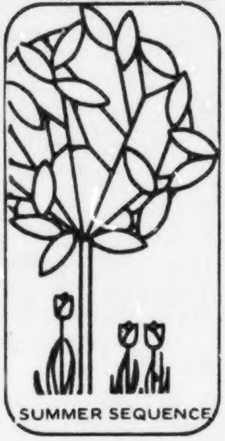
Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. Student chose a variety which could be grown in the summer growing season	☐	☐	☐	☐
2. Student included "time-to-root" and "time-to-transplant" on schedule	☐	☐	☐	☐
3. Student could name at least one reference which would help him/her plan a schedule	☐	☐	☐	☐

Learning Activity Package No. 21

GREENHOUSE
PRODUCTION



Selecting and Preparing a Medium for Propagating Cuttings

Ornamental Horticulture

INTRODUCTION

A number of different media have been used in propagating ornamental plants. Through trial and error and also by controlled experiments it has been found that some media will give better results than others in rooting certain plants. To be successful, the nursery operator must select the proper medium for the crop to be produced. This package will help you in selecting a suitable medium for propagating your cuttings. In addition, information is presented to guide you in preparing the selected medium.

DIRECTIONS

Read the objective. If you think that you are already able to perform this task, read the Check-Out Activity. Then either arrange with your instructor about doing the Check-Out Activity,

or

If you need further preparation in order to do the tasks, go through the Learning Activities.

OBJECTIVE

Given the references and information provided in this learning activity package the student will be able to select and prepare a medium for propagating cuttings which will hold the cutting in place, hold an adequate water supply and allow adequate air for the roots.

LEARNING ACTIVITIES

1 READ the following:

Plant Propagation Principles and Practices. Hartmann and Kester pp. 288-89.

or ______________________________

2 VISIT local plant nurseries and study their operation in plant propagation.

3 READ the Instructions, *A–A MEDIUM FOR PROPAGATING CUTTINGS.*

4 CHECK YOUR KNOWLEDGE of propagating media by taking Student Self-Check.

5 PREPARE a propagation media by following the Instructions on page 4.

6 ARRANGE with your instructor to complete this package by going through the Check-Out Activity.

TOOLS AND EQUIPMENT

None

MATERIALS AND SUPPLIES

None

SAFETY

Not Applicable

INSTRUCTIONS

A – A MEDIUM FOR PROPAGATING CUTTINGS

1. Is the selection of the rooting medium important for success in rooting cuttings?

   The proper rooting medium is very important as it influences not only the length of time it takes cuttings to root but also the percentage of the cuttings which will root. Some species will not root at all in some media.

2. What are the most commonly used media ingredients?

   (a) Soil – Although deciduous cuttings are often started outside in soil, soil is usually too fine in texture to be an ideal rooting media.

   (b) Sand – The most common medium used in plant propagation. Sand does not retain moisture very well, so needs to be watered often when used by itself. Peat moss is often mixed with sand to make a medium more retentive of moisture. The sand should be relatively free of clay, silt or organic matter. If sand is too fine it will prove unsuitable. In some areas local creek or river sand, if clean, is very satisfactory.

Figure 1. Two commonly used media ingredients – vermiculite and spaghnum peat moss.

   (c) Peat Moss – may be mixed with other media or used alone. An organic material, peat moss has very high waterholding capacity. Peat is acid in nature, a very favorable quality in rooting acid-loving plants. Peat moss should be one of the spaghnum types. Those of German or Canadian origin are favored.

   (d) Vermiculite – expanded mica with good waterholding capacity. Used by itself or mixed with other media, vermiculite is very useful in propagating softwood cuttings. A mineral substance, it has no plant food value.

   (e) Perlite – a volcanic material, very light in weight. Often used in place of some of the sand in mixtures to make a lighter, better aerated medium.

   Peat moss, vermiculite and perlite are all considered as sterile media and therefore do not have to be sterilized before using.

   Other ingredients used as rooting media include several kinds of bark, sawdust and redwood shavings. These may be extensively used near the areas where they are produced.

   There are a number of commercial "soilless" mixes on the market. Results in using some of these mixes have been very good in rooting cuttings. Where only a few cuttings are to be rooted, a grower may find it economical to use one of these commercial prepared mixes. You will find them listed in greenhouse and nursery supply catalogs.

3. What reference can I use to find a recommended media mixture for ornamental crops?

a. *The U.C. System for Producing Healthy Container Grown Plants—Manual 23.*

b. *Container Growing.* Ask your teacher if these publications are available in your department.

4. What are the criteria for evaluating propagation media?

   The rooting medium has to perform these three functions:

   (a) Hold the cuttings in place during rooting
   (b) Hold and supply water
   (c) Provide air for the roots

   In addition, the medium should be economical and readily available.

5. What equipment is commonly used to mix media ingredients for propagating cuttings?

   In visiting any nurseries which root cuttings, you should observe the tools and equipment which they use. While the rooting phase of plant propagation does not require a large quantity of media, the rooted cuttings are usually transplanted to containers which do require larger amounts of growing medium. The same equipment can be used to mix various media used in both the rooting and growing operations.

   Some of the equipment with which you should become familiar are: front-end loaders; concrete mixers, which are often adapted for mixing media; motorized soil grinder-shredders; specialized soil or media mixers.

   Unless the business is rather large, most nursery operators will depend on hand tools and equipment to mix media. Regardless of the system used, the important thing is to get a thorough, uniform mixture of the ingredients with a minimum of labor and other costs.

6. What are some commonly used media mixes for propagating nursery crops?

   A frequently used media mix for propagation consists of the following: ½ coarse washed sand and ½ peat moss.

   Another mixture often used consists of ½ sand and ½ vermiculite.

7. Is a media mixture necessary?

   No. Many plants root well in a single ingredient.

8. What type structure is needed for rooting nursery crops?

   The only structure needed for rooting most nursery stock is a cold frame with a cheesecloth or plastic cover. Greenhouses are seldom required, but may be used if cuttings are taken in late fall.

   Most nurseries simply make a frame using 10 inch (25.4 cm) boards, then add 4-6 inches (10-15 cm) of media and cover the frame with cheesecloth. Plastic covers may be used for a short time after sticking the cutting in order to hold as much moisture. Sprinkler irrigation is used after the plastic cover is removed.

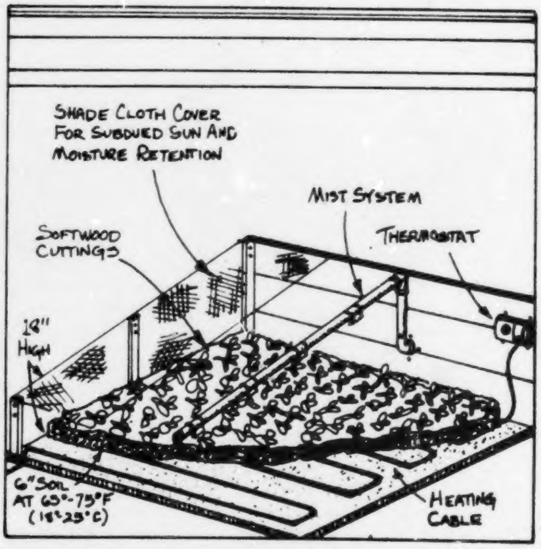

SHADE CLOTH COVER FOR SUBDUED SUN AND MOISTURE RETENTION
MIST SYSTEM
SOFTWOOD CUTTINGS
THERMOSTAT
18" HIGH
6" SOIL AT 65°-75°F (18°-25°C)
HEATING CABLE

Figure 2. A typical structure for rooting cuttings.

INSTRUCTIONS

B–PREPARING A PROPAGATION MEDIA

1. Select a rooting media, e.g., ½ coarse sand and ½ peat.
2. Roughly calculate the quantity of media needed. For example, in order to root 1,000 cuttings of azaleas spaced 2 x 2 in. (5 x 5 cm), approximately 30 square feet (2.8 sq. m) of space is required. And if the media is to be 4 inches (10cm) deep in the bench, then approximately 10 cubic feet (.3 cubic m) of medium is required. Of course, the amount of ingredients required would be slightly more than 5 cubic feet (.15 cubic m) of sand and 5 cubic feet (.15 cubic m) of peat. Why? Because when the two ingredients are mixed they, to some degree, fill the empty spaces within each other.
3. If only a small quantity is to be prepared, the medium may be mixed by hand scoop or by shovel.
4. If larger quantities are to be mixed, a soil mixer or cement mixer may save time.
5. If any of the materials used in the mixture have been used previously, they must be sterilized.

STUDENT SELF-CHECK

DO NOT WRITE ON THIS SHEET

SELECTING AND PREPARING A MEDIUM FOR PROPAGATING CUTTINGS

1. What type of plants are generally rooted outdoors with little or no protection?
2. In addition to soil, what are three other materials commonly used as rooting media?
3. Name a rooting medium which is very high in water holding capacity.
4. What are the three major functions of a rooting medium?
5. In what two ways does the kind of rooting medium used influence the rooting of the cuttings?

Compare your answers with the correct responses on this page. Review any incorrect answers before going on to the next learning activity.

CORRECT RESPONSES

1. Cuttings of deciduous plants are generally started outdoors in soil.
2. In addition to soil, three materials commonly used as rooting media are:
   - (a) sand
   - (b) peat moss
   - (c) vermiculite or perlite

   Others used are sawdust, pinebark, shavings.
3. Peat moss
4. The three chief functions of a rooting medium are:
   - (a) to hold the cuttings in place
   - (b) to hold and supply water
   - (c) to provide air for the roots
5. The rooting medium influences the rooting of cuttings in two ways:
   - (a) in the length of time required for the cuttings to root
   - (b) in the percentage of cuttings which root

CHECK-OUT ACTIVITY

In order to finish this learning activity package you must be able to complete the task(s) listed below. As you go through each activity, your instructor will rate your performance using the Instructor's Final Checklist.

Select a medium for propagating cuttings.

DO NOT WRITE ON THIS SHEET

LAP 21

Student ______________________

Date ______________________

SELECTING AND PREPARING A MEDIUM FOR PROPAGATING CUTTINGS

Instructor's Final Checklist

Check the student's performance in the following elements of selecting and preparing a medium for propagating cuttings.

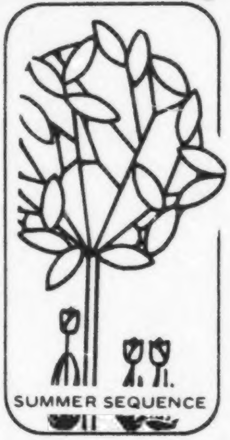
Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. Student could name at least one reference to aid in preparing a rooting medium.	☐	☐	☐	☐
2. Student used proper equipment to mix propagating medium	☐	☐	☐	☐
3. Student used a recommended propagation medium	☐	☐	☐	☐

Learning Activity Package No.22

GREENHOUSE PRODUCTION



STERILIZING SOIL

Ornamental Horticulture

INTRODUCTION

Soil is the home for many naturally occurring organisms. These include fungi, bacteria, insects, and weeds. These organisms can affect the growth and production of any horticulture crop. To rid the soil of these plant pests, growers in all phases of ornamental horticulture sterilize soil. Sterilization is a process in which practically all organisms in the soil are destroyed.

There are three commonly used methods of sterilizing soil: They are (1) steaming soil, (2) chemical sterilization, and (3) dry heat sterilization. In this learning activity package you will learn how to sterilize soil using each of the three methods.

DIRECTIONS

Read the objective. If you think that you are already able to perform this task, read the Check-Out Activity. Then either arrange with your instructor about doing the Check-Out Activity.

or

If you need further preparation in order to do the tasks, go through the Learning Activities.

OBJECTIVE

Given the necessary equipment and chemicals, sterilize soil using steam, chemicals or heat.

LEARNING ACTIVITIES

1 READ one or more of the following references:

Greenhouse Flowers and Bedding Plants, Williams, G. S., p. 45.

The Ball Red Book, George J. Ball, Inc., pp. 76-89.

2 READ the Instructions, *A–Facts About Sterilizing Soil.*

3 CHECK YOUR KNOWLEDGE of sterilizing soil by taking the Student Self-Check.

4 READ the Instructions, *B–Sterilizing Soil.*

5 OBSERVE another student as he or she performs or is checked out on this package.

6 ARRANGE with your instructor to complete this learning activity package by going through the Check-Out Activity.

TOOLS AND EQUIPMENT

Steam generator
Drying oven
Soil thermometer

MATERIALS AND SUPPLIES

Soil
Vinyl bench covers
Chemical bomb

SAFETY

Follow manufacturer's directions and obey safety precautions when sterilizing soil. Methyl bromide is extremely poisonous if swallowed or inhaled.

INSTRUCTIONS

A– FACTS ABOUT STERILIZING SOIL

1. Why is soil sterilized?

   Soil is sterilized to eliminate disease organisms, insect pests and weeds. Any one of these can easily get out of control and affect crop production.

2. How often should soil be sterilized?

   Soil should be sterilized when it is brought in from the fields before it is used for planting. Thereafter the soil should be sterilized whenever a new crop is started. Many growers find it is faster and cheaper to sterilize rather than replace soil. They may re-use the same soil for as long as 20 years!

3. Do all materials used as soil media have to be sterilized?

   No, some are considered as "sterile" in that they ordinarily do not carry harmful disease organisms, insects, or weeds. These include peat moss, perlite, vermiculite, and sand from pits.

4. What are the methods used to sterilize propagation media?

   The same sterilization methods can be used for both rooting media and growing media. The methods in common use are:

   (a) Steam – this method is fast, easy and inexpensive where large amounts of material are to be sterilized. In general, it is not applicable to small nurseries due to the need for an expensive boiler and other equipment.

   Where a steam jenny is available, it can be adapted to smaller scale steam requirements.

   In steam sterilization the soil or other media are heated to 180 degrees F (82 degrees C) and this temperature maintained for 30 minutes to accomplish sterilization. A soil thermometer is used to determine the proper soil temperature.

   (b) Electric soil sterilizer – this is probably the easiest and simplest method of any for sterilizing small quantities of soil or other media. The device consists of a box with either a 120 volt or 240 volt thermostatically controlled heating element which will raise the temperature of the contents to 180 degrees F (82 degrees C). A soil thermometer is necessary to determine when the necessary temperature is reached.

   Manufacturers supply electric sterilizers usually in sizes 1/8, 1/4, and 1/2 cu. yd. (.1, .2, and .4 cu. meter, respectively) A 120 volt model will sterilize two or three loads in a day. If a production schedule is set up and the electric sterilizer is emptied and reloaded quickly each time a load being sterilized is completed, then a small capacity sterilizer can handle quite a sizable quantity of material over a period of a few weeks.

   (c) Chemicals – for the small nursery operator where only a small quantity of media must be sterilized, treatment with chemicals may be the simplest and cheapest method.

There are a number of commercial preparations on the market which can be used in soil or other media sterilization. Refer to the chemicals section of one of your nursery and greenhouse supply catalogs for descriptions and uses of some of these materials. Described below are two chemicals which are commonly used for media sterilization:

(1) Methyl bromide – usually marketed as a gas in one pound pressurized cans. A special device for opening the can and dispensing the contents is necessary. This opener can be secured from the supply firm from which the chemical is purchased.

Methyl bromide has been found to be very effective in controlling fungi, weeds, nematodes and other insects. It is practical to use on field soils, plant beds and for sterilizing equipment such as flats, used pots and hand tools.

Methyl bromide is extremely poisonous and all precautions called for on the container must be observed to insure safety of the operator.

(2) Vapam (sodium N-methyl dithiocarbomate dihydrate) – is marketed as a liquid containing 4 pounds of the active material per gallon of solution. Vapam will control weeds, soil fungi, nematodes and other soil insects.

It is recommended that Vapam be applied when the temperature is between 55 and 65 degrees Fahrenheit (12.8 and 18.3 degrees C). No cover is needed over the treated soil or other material.

One week after treating, the top of the soil should be cultivated lightly. Two weeks after treatment the soil is safe to use.

INSTRUCTIONS

B– STERILIZING SOIL

1. Sterilizing With Steam

   a. Prepare the soil by adding organic material and mixing
   b. Moisten the soil uniformly
   c. Make sure the soil is not deep enough to prevent steam from completely penetrating
   d. Cover the soil with vinyl or other suitable material to retain steam
   e. steam the soil for one-half hour after the soil temperature reaches 180 degrees F (82 degrees C)

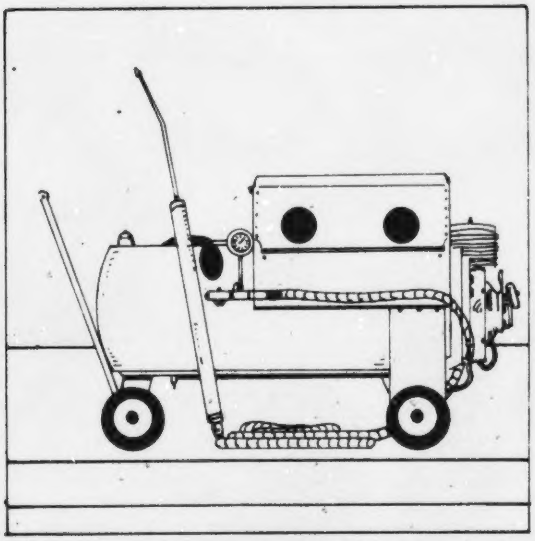


Figure 1. A steam "jenny" can be used to sterilize small quantities of soil using steam.

2. Sterilizing With Dry Heat

   a. Prepare the soil as above
   b. Place soil in the container supplied with sterilizer
   c. Turn on oven and heat to 180 degrees F (82 degrees C). Maintain 180 degrees F (82 degrees C) for 30 minutes
   d. Remove soil and reload oven with the next soil batch

3. Sterilizing With Chemicals

   Using methyl bromide: Caution – methyl bromide is very poisonous. Use all precautions listed on container. Use only when air temperature is above 50 Degrees F (10 degrees C).

a. Pile soil media to a depth of about one foot (30 cm), preferably on a concrete surface. If concrete is not available, lay a tarp on the ground and uniformly cover with soil media. Remove coarse soil material by screening.

b. Place glass bottles upright on the soil material to support the covering and allow the gas to circulate.

c. Cover soil with polyethelene. Seal the edges with soil. Make sure there is air space between soil and covering.

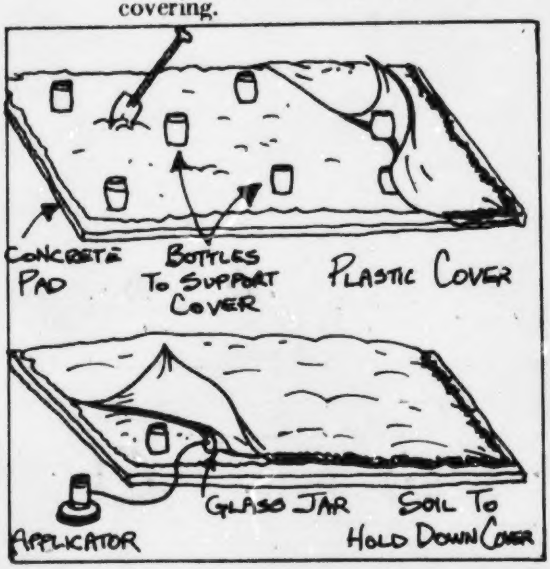


Figure 2. Sterilizing soil using methyl bromide.

d. Apply the methyl bromide at rate of 1.5 to 2 pounds per 100 sq. ft. (.675 to .90 kg. per 9 sq. m) for weed and nematode control, use 4 pounds per 100 sq. ft. (1.8 kg. per 9 sq. m) for fungus control.

e. Remove the cover after 24-48 hours. Allow the soil to aerate for at least 48 hours before use.

4. Using Vapam

a. Prepare soil material by spreading to a depth of about one foot (.3048 m).

b. To use Vapam, add one quart (.95 l) of vapum to 2 or 3 gallons (7.6 or 11.4 l) in a sprinkling can. Mix thoroughly.

c. Sprinkle soil material until the soil is moistened uniformly to a depth of 6 inches (15 cm). A "Hozon" or other hose proportioner on 1 to 15 can be used to apply Vapam. One quart (.95 l) of Vapam is mixed with 3 quarts (2.85 l) of water, then applied uniformly to the soil media. Continue soaking until it is wet to a depth of 6 inches (15 cm).

STUDENT SELF-CHECK
DO NOT WRITE ON THIS SHEET
STERILIZING SOIL

Directions: Circle the letter of the line(s) that best completes the statement.

1. Soil should be sterilized to:

   (a) eliminate disease organisms
   (b) save time and money replacing old soil with new soil
   (c) both of the above

2. When sterilizing soil by steaming, you should:

   (a) make sure the soil is dry so steam penetrates
   (b) steam for one-half hour after the coolest soil temperature is 180 degrees F (82 degrees C)
   (c) always add organic material after steaming is completed

3. Chemical sterilization is:

   (a) probably best for the small operation
   (b) potentially very dangerous
   (c) more portable than steaming

4. An electric soil sterilizer is:

   (a) probably the simplist method
   (b) used only for small soil batches
   (c) practical in the field

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next learning activity.

CORRECT RESPONSES

1. (c)
2. (b)
3. (a), (b)
4. (a)

CHECK-OUT ACTIVITY

In order to finish this learning activity package you must be able to complete the task(s) listed below. As you go through each activity, your instructor will rate your performance using the Instructor's Final Checklist.

Sterilize soil using steam.

Sterilize soil using dry heat.

Sterilize soil using chemicals.

DO NOT WRITE ON THIS SHEET

LAP 22

Student ____________________

Date ____________________

STERILIZING SOIL

Instructor's Final Checklist

Check the student's performance in the following elements of sterilizing soil.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
STERILIZING WITH STEAM				
1. Soil uniformly moistened	[ ]	[ ]	[ ]	[ ]
2. Soil not more than 12" (30.5 cm) deep	[ ]	[ ]	[ ]	[ ]
3. Cover fastened securely to bench	[ ]	[ ]	[ ]	[ ]
4. Soil steamed for at least 30 minutes at 180° F (82 ° C)	[ ]	[ ]	[ ]	[ ]
STERILIZING WITH DRY HEAT				
1. Soil heated for at least 30 minutes at 180° F (82° C)	[ ]	[ ]	[ ]	[ ]
STERILIZING WITH CHEMICALS				
1. Soil was leveled to a depth of about 1 ft. (30 cm)	[ ]	[ ]	[ ]	[ ]
2. Temperature of soil recorded above 50° F (10° C)	[ ]	[ ]	[ ]	[ ]
3. Soil covered securely, air space present	[ ]	[ ]	[ ]	[ ]
4. Administered chemical at recommended rate	[ ]	[ ]	[ ]	[ ]
5. Cover was left on for at least 24 hours	[ ]	[ ]	[ ]	[ ]
6. Buried empty chemical containers	[ ]	[ ]	[ ]	[ ]
7. Manufacturer's precautions and safety factors were closely followed	[ ]	[ ]	[ ]	[ ]

Learning Activity Package No.23

GREENHOUSE
PRODUCTION

SUMMER SEQUENCE

SELECTING CUTTING MATERIAL

Ornamental Horticulture

INTRODUCTION

In order for cuttings to root successfully, the plants from which the cuttings are taken must be in the proper stage of growth. The best stage of growth will vary with the species and variety of plant.

In this package you will receive information to help you in comparing various stages of plant growth and to identify the type of plant material which will root most successfully.

DIRECTIONS

Read the objective below. If you think that you are already able to perform these tasks, read the Check-Out Activities. Then, either arrange with your instructor about doing the Check-Out Activities.

or

If you need further preparation in order to do the tasks, go through the Learning Activities.

OBJECTIVE

When given a variety of cuttings of varying hardness and stages of growth, identify those appropriate for cutting materials.

LEARNING ACTIVITIES

1 READ one or more of the following:

Landscaping the Home and School Grounds. South Carolina Department of Education, pp. 22-23.

Plant Propagation – Principles and Practices. Hartmann and Kester, pp. 273-288. If information is needed about a specific plant see chapters 17, 18, or 19.

2 READ the Instructions, *A–What You Need To Know To Select Cutting Materials.*

3 CHECK YOUR KNOWLEDGE by taking Student Self-Check.

4 READ the Instructions, *B- Selecting Cutting Material.*

5 ARRANGE with your instructor to complete this package by going through the Check-Out Activity.

TOOLS AND EQUIPMENT

None

MATERIALS AND SUPPLIES

Access to different types of plant material

SAFETY

No special precautions

INSTRUCTIONS

A– ~~WHAT~~ YOU NEED TO KNOW TO SELECT CUTTING MATERIAL

1. Since plants vary so widely in their growth habits – some being deciduous and some evergreen, some are woody and some are succulent – can cuttings from all types be propagated at the same stage of growth?

   No, different varieties of plants may vary widely as to the stage of growth or "ripeness" of the wood which will root best. In classifying them as to their stage of growth, cuttings are usually considered under three types, as follows:

   (a) Softwood cuttings
   (b) Semi-hardwood cuttings, sometimes called greenwood cuttings
   (c) Hardwood cuttings

2. What is a softwood cutting?

   Softwood is classed as green, succulent, or immature wood. It is the active growth of the current season before it has hardened up.

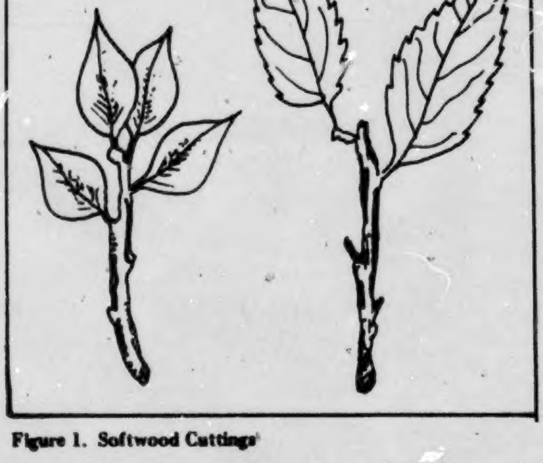


Figure 1. Softwood Cuttings

3. What plants are propagated by softwood cuttings?

   Softwood cuttings are a fast method of rooting many flowering trees and shrubs. Azalea, magnolia, forsythia, and weigela can be propagated with this type of cutting. Also see Table on page 4.

   Where a mist system is available to prevent the tender cutting from wilting, many of the species generally rooted from semi-hardwood cuttings will root readily if taken at the softwood stage of growth.

4. What is a semi-hardwood or greenwood cutting?

   A semi-hardwood cutting is one made from wood which has slightly hardened. After the first surge of spring growth is over the wood becomes semi-hardened. It may be somewhat larger than softwood and with a larger number of nodes and internodes.

5. What are some plants propagated by means of semi-hardwood cuttings?

   A few of those which are commonly increased by cuttings of semi-hardwood are: azalea, camellia, American holly, magnolia, pyracantha, rhododendron, and Japanese and Chinese hollies. Also see Table on page 4.

6. What is a hardwood cutting?

   A hardwood cutting is a cutting taken from a completely mature stem or twig. The plant from which it is made is fully dormant with no obvious sign of growth to be seen. The wood of the cutting is firm, usually stiff and unbending.

   There are three types of hardwood cuttings:
   (a) Deciduous hardwood cuttings
   (b) Broad-leaf evergreen hardwood cuttings
   (c) Coniferous evergreen hardwood cuttings

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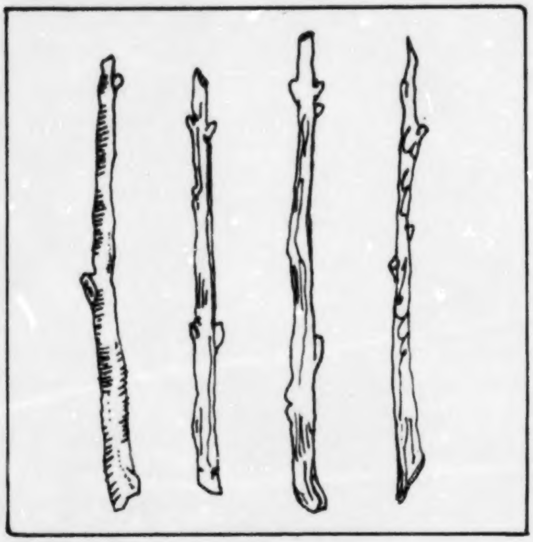


Figure 2. Hardwood Cuttings

7. What are some of the plants which are rooted from hardwood cuttings?

   Among the numerous species rooted from hardwood cuttings are Boxwood, Camellia sasanqua, Ilex cornuta, Ilex crenata, Ilex opaca, and varieties of Thuja (Arborvitae) and Juniper.

8. Can some species be rooted at more than one stage of growth?

   Yes, some plants can be rooted at two or even all three growth stages. This can extend the season for rooting these particular plants over quite a long season or into several seasons of the year.

9. What species of plants will give better results in rooting if stock plants are first subjected to seasonal frosts before cuttings are taken?

   Cuttings from coniferous evergreens usually will root better if the cuttings are secured from stock plants during the dormant period, after one or more hard frosts.

STUDENT SELF-CHECK
DO NOT WRITE ON THIS SHEET
SELECTING CUTTING MATERIALS

Directions: Select the letter of the line that best completes the statement.

1. From what type of plant growth is a softwood cutting obtained?

   (a) dormant, woody stems
   (b) greenwood cuttings
   (c) succulent immature wood

2. What is the test to determine if plant material is softwood?

   (a) Snaps cleanly in half when bent
   (b) Bends but will not break
   (c) Looks like new growth

3. Cuttings taken from fully mature wood after it has become dormant are:

   (a) Softwood cuttings
   (b) Semi-hardwood cuttings
   (c) Hardwood cuttings

Compare your answers with the correct responses on this page. Review any incorrect answers before going on to the next learning activity.

CORRECT RESPONSES

1. (c)
2. (a)
3. (c)

CHECK-OUT ACTIVITY

In order to finish this learning activity package, you must be able to complete the task(s) listed below. As you go through each activity, your instructor will rate your performance using the Instructor's Final Checklist.

Identify recommended cutting material.

PROPAGATION METHODS FOR SELECTED ORNAMENTAL SHRUBS

Name	Method	Wood	Time	Remarks
Azalea (Azalea "Indica")	Cuttings	Softwood	July thru Aug.	
Chinese Holly (Hex Cornuta)	Cuttings	Softwood or hardwood	July thru Aug. late Nov. thru mid-March	Some varieties may require wounding and application of correct hormone.
Photinia (Photinia "Fraseri")	Cuttings	Softwood	July thru Aug.	
Pittosporum (Pittosporum Tobia)	Cuttings	Softwood	July thru Aug.	
Formosa Firethorn (Pyracantha)	Cuttings and seeds	Semi-hardened	Sept. thru Oct.	Seed may be the fastest way to produce a large volume.
Abelia (Abelia Grandiflora)	Cuttings and layering	Softwood or hardwood	July thru mid-Oct., early spring	
Boxwood (Buxus)	Cuttings	Softwood or hardwood	Spring and fall	
Japanese Holly (Hex Crenata)	Cuttings	Softwood or hardwood	July thru Aug., Nov., thru mid-March	
Pfitzer Juniper (Juniperus chinensis pfitzeriana)	Cuttings	Hardwood	Dec. thru Jan.	Light wound is helpful.
Nandina (Nandina Domestica)	Seed		October	
Hybrid Rhododendron (Many varieties)	Cuttings	Semi-hardened	Mid-Aug. thru Oct.	Rather difficult to root. Wound heavily.
American Holly (Hex opaca)	Cuttings	Softwood or hardwood	July thru Aug., Sept. thru March	Wound heavily.
Camelia (Camelia japonica)	Cuttings	Semi-hardened	Aug. thru Sept.	Wound
Tea Olive (Osmanthus delavayi)	Cuttings	Softwood	July thru Aug.	

A more complete list of plants along with methods of propagation are given in plant propagation books.

[1] Vocational Education Media Center, *Landscaping the Home and School Grounds,* (Clemson, SC: The center, 1970), p. 23.

DO NOT WRITE ON THIS SHEET

LAP 23

Student ______________________

Date ______________________

SELECTING CUTTING MATERIAL

Instructor's Final Checklist

Check the student's performance in the following elements of selecting cutting material.

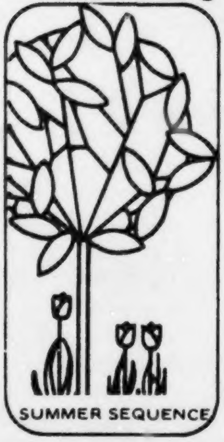
Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

		Student Performance			
		Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1.	Student named at least one source that could be used to identify hard and soft woods	☐	☐	☐	☐
2.	Student correctly identified softwood cutting material	☐	☐	☐	☐
3.	Student correctly identified semi-hardwood cutting material	☐	☐	☐	☐
4.	Student correctly identified hardwood cutting material	☐	☐	☐	☐
5.	Student correctly matched selected plant materials and type of cutting recommended for propagation	☐	☐	☐	☐

Learning Activity Package No. 24

GREENHOUSE
PRODUCTION



TAKING CUTTINGS

Ornamental Horticulture

INTRODUCTION

There are a number of factors which contribute to successful rooting of selected cuttings. One very important factor is proper preparation of the cuttings. Cuttings improperly made and carelessly handled will not root or, if they do root, they can grow so poorly as to be almost worthless.

This package will outline procedures for preparing cuttings of ornamental plants so as to insure their successful rooting.

DIRECTIONS

Read the objective below. If you think that you are already able to perform these tasks, read the Check-Out Activities. Then, either arrange with your instructor about doing the Check-Out Activities,

or

If you need further preparation in order to do the tasks, go through the Learning Activities

OBJECTIVE

Given the necessary tools and plant materials. prepare cuttings of ornamental plants so as to insure their successful rooting.

LEARNING ACTIVITIES

1 READ one or more of the following:

Landscaping the Home and School Grounds. South Carolina Department of Education, pp. 23-24.

Plant Propagation – Principles and Practices. Hartman and Kester, pp. 278-84.

2 READ the Instructions, *Taking Cuttings.*

3 CHECK YOUR KNOWLEDGE by taking the Student Self-Check.

4 ARRANGE with your instructor to complete this package by going through the Check-Out Activity.

TOOLS AND EQUIPMENT

Hand pruning shears
Sharp knife

MATERIALS AND SUPPLIES

Rooting hormone
Basket or crate with wet burlap liner
Supply of stock plants

SAFETY

Use care handling knives and pruning shears.

INSTRUCTIONS

TAKING CUTTINGS

1. How many leaves should be left on cuttings when they are prepared for rooting?

   Except for deciduous hardwood cuttings which are taken during the dormant season, some leaves must be left on cuttings in order to help transpire moisture and to manufacture food for the developing plant. If too many leaves remain, the cutting may wilt. If mist is used, more leaves can be left on the cutting. A general rule is to leave 1/3 of the leaves, removing the lower 2/3. With larger leaves, 2 or 3 leaves are left on the cutting and if the leaves are very large they may be trimmed to 1/4 to 1/2 size.

   Cuttings from which the leaves strip easily can be stripped by hand. If difficult to remove, or if large patches of bark tend to strip off with the leaves, then a knife can be used for trimming the leaves.

2. What are rooting hormones?

   Rooting hormones or "rooting compounds" are chemicals which are used on cuttings to aid in the more rapid development of roots. They also increase the percentage of cuttings that do root.

   Some species of plants show little response to the use of rooting hormones. On the other hand, a rooting hormone, often combined with wounding, may greatly increase the success in propagating some difficult to root species.

   Rooting hormones are available as powders or liquids. The powders are more available on the market and are simpler to apply.

   A usual way to apply the powders to the prepared cuttings is to dampen the cutting by dipping the lower end in water, then shaking off the excess water. The dampened stem is then dipped into the powdered chemical to a depth of 1 in. (2.5 cm) or slightly more. A tap of the stem on the rim of the container will shake off excess powder. Several cuttings may be handled together at one time in doing this. After treatment, the cutting is inserted in a hole or a slit in the rooting medium, care being taken not to dislodge the powder.

   There are several different chemicals sold as aids to rooting and some are sold in more than one strength. Some also contain a fungicide to help prevent disease. Directions on the container will list the kinds of shrubs for which the material is recommended. Also it will contain specific instructions on how to use the compound.

   Trade names of some of the more common rooting hormones are Chloromone, Hormodin and Rootone.*

3. In the warm and humid atmosphere of a rooting bed, how are cuttings kept free of disease?

   Careful attention is necessary to prevent disease while rooting cuttings. Conditions of high moisture and temperature which are necessary for cuttings to root are also ideal for development of many disease organisms which can cause the cuttings to rot. Some of the disease preventative measures growers have found useful are:

   (a) Treat all wood used in flats, frames, benches, etc. with a solution of copper naphthenate. The wood can be painted with the solution, or flats can be dipped in it. Old wooden flats should be cleaned and repainted each year to sterilize them. Copper Naphthenate 2% solution can be purchased at building supply

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*The inclusion or exclusion of brand names of commercial materials is not meant as an endorsement of the products listed.

INSTRUCTIONS (cont'd.)

dealers or the concentrate can be purchased and diluted according to directions with paint thinner to a 1½% or 2% concentration of copper. Do not use creosote as a wood preservative near plants as the fumes are very harmful.

(b) Use a sterile rooting medium. If the medium you will use for your cuttings is not already sterile, you will find directions for sterilizing it in Package 22.

(c) Use cuttings from only healthy disease-free stock plants. Cuttings taken from high up on the plant will be less apt to be diseased than those from branches which touch the ground.

(d) If disease has previously been a problem, cuttings should be dipped in a fungicide solution. Among those which can be used are Captan, Fermate, Orthocide, Pano-drench, Semesan, Tersan 75, Terrachlor, or Zerlate.*

4. In preparing cuttings for rooting, to what length should they be cut?

The length to make cuttings depends on many factors, but one of the main considerations is the type of cutting. The following are considered as average lengths for various types of cuttings:

(a) Softwood cuttings: 3 - 4 in. (7 - 10 cm); cut 1/2 in. (1.27 cm) below a node at a 45 degree angle

(b) Semi-hardwood cuttings: 3 - 6 in. (7 - 15 cm); cut just below a node

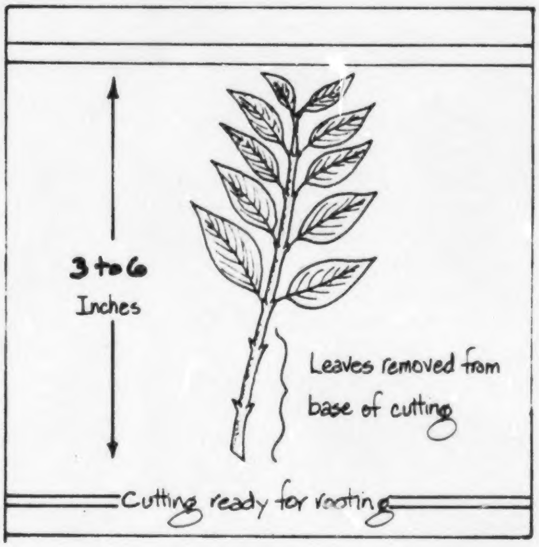
3 to 6
Inches
Leaves removed from base of cutting
Cutting ready for rooting

Figure 1. Semi hardwood cuttings should be 3 to 6 inches (7-15 cm).

(c) Decidious hardwood cuttings: 6 - 10 in. (15 - 25 cm)

(d) Coniferous hardwood cuttings: 4 - 8 in. (10 - 20 cm); with some species a heel of old wood should remain on the cutting.

Among the considerations in determining how long to make cuttings is the relative abundance or scarcity of propagation wood. If stock plants are plentiful, cuttings may be of maximum length. If cutting wood is scarce, as, for example in propagating a new or rare variety, then cuttings may be much shorter. Generally, the larger the cutting, the more successfully it will root.

A sharp knife is uaually considered the best instrument to use in preparing cuttings. Generally a sharp knife will bruise the tissue around the cut stem less than will pruning shears which may tend to mash the softer stems. With many species it doesn't seem to make much difference which method is used. Azaleas are often snapped or broken off instead of being cut. This saves time and the cuttings root just as well as those carefully cut.

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*The inclusion or exclusion of brand names of commercial materials is not meant as an endorsement of the products listed.

5. What precautions should be taken to prevent cuttings from drying out during their preparation?

If cuttings dry out at any time during the preparation process or during the rooting period, rooting failure will be high. Some steps to take to prevent cuttings from drying out are the following:

(a) Obtain cuttings from stock plants early in the morning while the leaves and stems are still fully charged with water.

(b) Place cuttings in a container such as a bushel basket and cover with wet burlap.

(c) After taking cuttings from the stock plants they should be prepared and placed in the rooting flats or beds as quickly as possible.

6. What is meant by "wounding" a cutting?

Wounding consists of deliberately slashing or cutting through the bark near the base of a cutting. The wounding stimulates the production of roots on some types of cuttings, especially if the cutting, including the wounded area, is treated with a rooting hormone. What is known as a "light" wound is made by using a sharp knife to make a cut through the bark to the cambium layer. The cut should be at the base of the cutting and about 1½ inches (3.8 cm) in length. Some growers make a tool from single edge razor blades for applying a light wound. Four blades are held in a vise and then the shoulders soldered together to make this special tool.

A "heavy" wound is often recommended for cuttings with a large stem or for those more difficult to root. To make a heavy wound a thin slice of bark is removed from one side at the base of the cutting. The cut should be just through the bark to expose the cambium layer, and about 1½ in. (3.8 cm) in length.

STUDENT SELF-CHECK
DO NOT WRITE ON THIS SHEET
PREPARING CUTTINGS FOR ROOTING

Directions: Give the correct short answer to the following questions.

1. How many leaves should be left on a cutting?
2. How is a rooting hormone applied to a cutting?
3. With what chemical is the wood used in plant propagation treated, in order to prevent disease and decay?
4. To what length should softwood cuttings be cut?
5. Why are cuttings sometimes "wounded"?

Compare your answers with the correct responses on this page. Review any incorrect answers before going on to the next learning activity.

CORRECT RESPONSES

1. About 1/3 of the leaves should remain on the cutting. If the leaves are large keep 2 or 3 of the leaves on the tip.
2. The cutting is dampened, then the base of the cutting inserted in the rooting chemical. The excess powder is then shaken off.
3. Copper Naphthenate solution is used in treating wood used around plants.
4. Softwood cuttings are usually cut to a length of about 3 to 4 in. (7 - 10 cm).
5. Wounding stimulates the formation of roots from the exposed cambium layer, with some species of plants.

CHECK-OUT ACTIVITY

In order to finish this learning activity package you must be able to complete the task(s) listed below. As you go through each activity, your instructor will rate your performance using the Instructor's Final Checklist.

Prepare cutting for rooting.

DO NOT WRITE ON THIS SHEET

LAP 24

Student ____________________

Date ____________________

PREPARING CUTTINGS FROM ORNAMENTAL PLANTS FOR ROOTING

Instructor's Final Checklist

Check the student's performance in the following elements of preparing cuttings from ornamental plants for rooting.

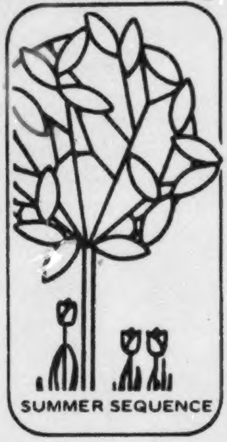
Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. Student removed all but 1/3 of the leaves from the cutting	☐	☐	☐	☐
2. Student chose the recommended length of cutting	☐	☐	☐	☐
3. Student dipped cutting in rooting hormone	☐	☐	☐	☐
4. Student took necessary precautions against disease in flats	☐	☐	☐	☐
5. Student took precautions to prevent the root from drying out	☐	☐	☐	☐

Learning Activity Package No.25

GREENHOUSE
PRODUCTION



ROOTING CUTTINGS

Ornamental Horticulture

INTRODUCTION

Having carefully prepared cuttings for propagation, the nursery operator has just two other steps to properly complete to insure a supply of well rooted liners.

The first of these final steps is to place the cuttings in the flats or other rooting structures so they will receive optimum growing conditions. At the same time it must be kept in mind that rooting space is valuable and the maximum production must be realized in the smallest area possible.

The second of the final two steps in rooting cuttings is to see that the required environment is maintained during the rooting process.

This package will help you to properly place the cuttings you have prepared in the rooting medium, and to provide an environment for their successful rooting.

DIRECTIONS

Read the objective below. If you think that you are already able to perform these tasks, read the Check-Out Activities. Then, either arrange with your instructor about doing the Check-Out Activities,

or

If you need further preparation in order to do the tasks, go through the Learning Activities.

OBJECTIVES

Place cuttings using recommended procedures. Plan the environment for rooting a selected or typical bed of stem cuttings.

LEARNING ACTIVITIES

1 READ one or more of the following:

Landscaping the Home and School Grounds. South Carolina Department of Education, p. 22.

Plant Propagation – Principles and Practices. Hartmann and Kester, pp. 278-284.

2 READ the Instructions, *A – Placing Cuttings and Maintaining the Proper Environment.*

3 CHECK YOUR KNOWLEDGE by taking the Student Self-Check.

4 READ the Instructions, *B– Placing Cuttings.*

5 **ARRANGE** with your instructor to complete this package by going through the Check-Out Activities.

TOOLS AND EQUIPMENT

Soil thermometer
Knife
Straight edge

SUPPLIES AND MATERIALS

Rooting medium in benches
Cuttings

SAFETY

Not applicable

INSTRUCTIONS

A–PLACING CUTTINGS

1. How deep should cuttings be placed in the rooting medium?

   The general rule is to place about 1/2 of the stem of the cutting in the rooting medium. But some growers using mist systems have had better success by inserting cuttings in the rooting medium just deep enough to keep the cutting upright. Results may vary according to just how wet the medium is kept during rooting. The 1/2 length of cutting depth can be considered a safe rule to follow until you can try other depths on a small scale under your particular conditions.

2. How far apart should cuttings be spaced in the rooting bed?

   Spacing was discussed in Learning Activity Package No. 19 as it affects the amount of rooting bed space needed to produce a given number of plants. For uniformity and convenience in handling, cuttings should be inserted in rows a measured distance apart. Rows spaced 2 in. (5 cm) apart are sufficient with most species. With large cuttings or cuttings with large leaves you can increase the spacing to a distance of 3 or 4 in. (7.6 or 10 cm). Use a short length of 2 x 4 in. (5 x 10 cm) lumber or other straight edge to help in making uniform rows. A large knife, trowel, or piece of sheet metal is used to cut a furrow or opening into the rooting medium for inserting the cuttings.

   Space cuttings in the rows about 1 inch (2.54 cm) apart for small cuttings, 2 inches (5 cm) apart for large cuttings. Leaves on cuttings can just touch but should not overlap to any extent.

   After each row of cuttings is placed, the rooting medium is firmed against the cuttings. After all are in place the flat or bed is thoroughly soaked to further firm and settle the medium.

   At this point too, label your cuttings. Be sure to use labels that moisture will not damage.

   A few species of ornamentals can be propagated from hardwood cuttings taken during the dormant season and rooted in open ground. These might include such ornamentals as Hydrangea, Flowering Quince, Rose, Willow and Wisteria. This type of cutting is placed 3 or 4 inches (7.5 or 10 cm) apart in rows spaced 6 to 8 inches (15 to 20 cm) or even wider.

3. After cuttings are placed in the rooting medium and watered in, what care should be taken of them until they have rooted?

   All plants must have a favorable environment in order to live and develop. This is especially true with stem cuttings which have been severed from the parent plant which had supplied it with food and water. The environmental factors which have an influence on the ability of a cutting to root and develop are humidity, the amount of light, the temperature, and relative amounts of moisture and air in the rooting medium. Properly controlling these factors depends on an understanding of their relationship to each other and to the plant's development.

INSTRUCTIONS

B–MAINTAINING THE PROPER ENVIRONMENT

1 What is the effect of humidity on cuttings being rooted?

If the atmosphere surrounding the cutting is very dry, then transpiration of moisture from the cutting is so rapid that wilting occurs. The stem cannot absorb water from the medium as fast as the leaves give it off to the atmosphere. In a short time the cutting will die. The ideal condition is to maintain such a high humidity, that is, so much moisture in the air, that transpiration from the leaves and stem is kept to a minimum. There are several ways in which this may be done. One of the best is by use of a mist system. The leaves of the cuttings are kept constantly moist and the atmosphere very humid from the mist, especially during daylight hours when transpiration tends to be most rapid.

Another way to maintain a relatively high humidity is by use of a tightly enclosed area. There are several ways to accomplish this. In a greenhouse, humidifiers can be used or the cuttings can be misted by hand several times a day. Some growers use special closed frames for rooting cuttings. Tightly closed, these glass or plastic enclosed frames will maintain a relatively humid atmosphere about the plants. With these enclosures, shading is necessary and a close watch maintained to prevent excessive heat build-up in hot weather. If they become too hot, some ventilation must be provided.

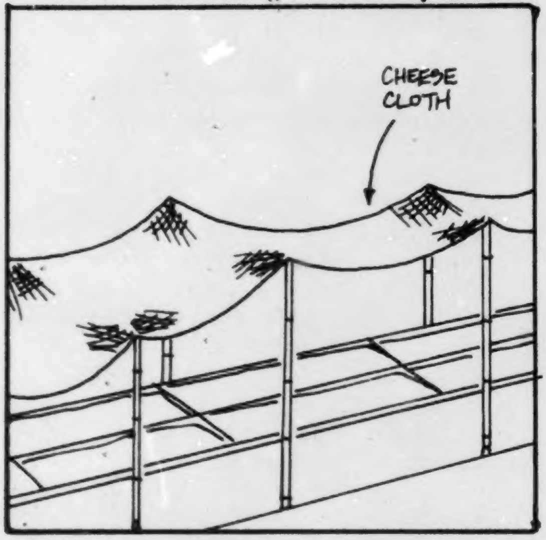


Figure 1. Shading is usually necessary when cuttings are rooted under plastic.

One device which has been used with good results is to place the cuttings in wooden flats, then enclose them in polyethelene "tents" to maintain the humidity. With this method the plants are somewhat "self-watering". Once the cuttings are well watered when placed in the flat, the moisture which transpires from them condenses on the plastic cover and falls back to the medium to keep it moist. It is usually not necessary to water the cuttings again until they have rooted. These rooting boxes must be placed out of the direct rays of the sun. On page 40 of your manual *Landscaping the Home and School Grounds* you will find a diagram and directions for constructing this type of propagation box.

Regardless of the method used to maintain a high humidity in rooting cuttings, once roots are well formed the humidity should be gradually reduced such that the young plants gradually become accustomed to somewhat dryer growing conditions.

2. How much light should cuttings receive?

To form roots and begin the development of new stems and leaves, photosynthesis must take place within the cutting. The higher the light intensity, the greater the amount of photosynthesis. An advantage of a mist system is that cuttings do not have to be shaded as the misting prevents water loss from the cutting, even in the sun. If a mist system is not used, some shading must be provided in order to hold down the rapid transpiration of moisture. Lath or shade cloth is usually used to provide approximately 50 percent shade. If there is too much shade, growth on cuttings will be soft and stretched.

3. What is the best temperature for rooting cuttings?

Plants vary in their temperature requirements. As mentioned above, plants cannot be allowed to become too hot as they can be "cooked". A mist system will keep the temperature within safe limits even on the hottest day. If mist is not used, normal air temperature is satisfactory if shading is provided and the rooting medium is sufficiently moist. In the winter, if cuttings are to continue to root, then a heated greenhouse or hotbed must be provided.

Perhaps even more important than air temperature in the rooting of cuttings is the temperature about the roots. Where heat from a source such as an electric heating cable can be provided under the rooting medium, rooting will often be much more rapid and complete. A bottom heat of 65 to 75 degrees Fahrenheit (18 to 24 degrees C) should be maintained. Often the air temperature can be quite high but due to the moisture in the medium the temperature in the root zone is lower than the optimum. A soil thermometer should be available to make this determination.

4. How does the supply of water and air in the soil influence the rooting of cuttings?

Both water and oxygen from the air are necessary for roots to grow. The rooting medium must be carefully chosen with the objective of maintaining a proper balance between moisture and air with the system of propagation to be used. Among the media in use, peat moss and vermiculite tend to have high water holding capacities.

Sand or perlite hold less water, therefore carry more air space. They are often mixed with other media which will better retain water. If used by themselves special attention must be given to drainage. Wire mesh or gravel may be used as a base to insure good drainage.

You can see from this that the successful propagator must study the conditions of both the plants and the medium in which they are placed, checking regularly to see that the moisture is properly maintained to insure optimum growing conditions. Where a high humidity can be maintained, water loss is lower and beds or flats will not have to be watered so frequently.

With a mist system, rooting beds may need no supplemental watering, depending on the medium being used and the amount of mist. But even with a mist system the moisture in the rooting medium will require regular checking as it can dry out even though the leaves of the cuttings and the surface of the medium may seem quite wet.

Be careful not to overwater because cuttings will decay or roots will form very slowly due to an insufficient supply of oxygen.

STUDENT SELF-CHECK

PLACING CUTTINGS
DO NOT WRITE ON THIS SHEET

Directions: Select the one best answer to each of the following statements:

1. An average depth to place cuttings in the rooting medium is:

   (a) 1/4 of the length of the cutting
   (b) 1/3 of the length of the cutting
   (c) 1/2 of the length of the cutting
   (d) 3/4 of the length of the cutting

2. An average spacing in the rooting bed for smaller cuttings is:

   (a) 1 x 2 in. (2.5 x 5 cm)
   (b) 2 x 4 in. (5 x 10 cm)
   (c) 2 x 10 in. (2 x 25 cm)
   (d) 4 x 5 in. (10 x 12½ cm)

3. The purpose of tightly enclosing the bench, frame or flat containing cuttings is to:

   (a) Increase the temperature
   (b) Increase the humidity
   (c) Keep out air
   (d) Prevent disease

4. Most plants will root best if the temperature of the medium in the root zone of the cuttings is about:

   (a) 55 – 60 degrees F. (13 – 16 degrees C.)
   (b) 65 – 75 degrees F. (18 – 24 degrees C.)
   (c) 80 – 90 degrees F. (27 – 32 degrees C.)
   (d) 90 – 100 degrees F. (32 – 38 degrees C.)

5. Photosynthesis will be increased and cuttings will root faster if light conditions are:

   (a) Complete shade
   (b) Very low light
   (c) Intense light
   (d) Light is immaterial

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next learning activity.

CHECK-OUT ACTIVITY

In order to finish this learning activity package you must be able to complete the task(s) listed below. As you go through each activity, your instructor will rate your performance using the Instructor's Final Checklist.

Place cuttings.

Plan the environmental schedule.

CORRECT RESPONSES

1. (c) 1/2 of the length of the cutting
2. (a) 1 x 2 in. (2.5 x 5 cm)
3. (b) Increase the humidity
4. (b) 65 – 75 degrees F. (18 – 24 degrees C.)
5. (c) Intense light

DO NOT WRITE ON THIS SHEET

LAP 25

Student ____________________

Date ____________________

PLACING CUTTINGS AND PLANNING THE ENVIRONMENT FOR ROOTING A TYPICAL BED OF STEM CUTTINGS

Instructor's Final Checklist

Check the student's performance in the following elements of placing cuttings and planning the environment for rooting a typical bed of stem cuttings.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. Student placed cutting so that about 1/2 of the stem of the cutting was in the rooting media	☐	☐	☐	☐
2. Cuttings were spaced to provide room for root growth while fully utilizing pan or bench area (1 inch for small plants; 2 inches for large plants) (2.5 cm; 5 cm)	☐	☐	☐	☐
3. Relative humidity kept high at all times.	☐	☐	☐	☐
4. Bottom heat of 65 to 75 degrees F (18 - 24 degrees C) maintained.	☐	☐	☐	☐

RECOMMENDED STUDENT REFERENCES

*1. *Annuals – Time Life Series of Gardening,* Crockett, J.U., Time-Life Books, Alexandria, Virginia, 1971.

2. *Ball Red Book,* 13th edition, Ball, Vic (Editor), George J. Ball Inc., Chicago, Illinois, 1975.

**3. *Bedding Plants,* 2nd edition, Mastalerz, John W., Pennsylvania Flower Growers, University Park, Pennsylvania, 1976.

4. *Flower and Plant Production,* 3rd edition, Nelson, K. S., The Interstate Printers and Publishers, Danville, Illinois, 1967.

5. *Greenhouse Crop Production – A Student Manual,* Department of Agricultural Education, The Pennsylvania State University, University Park, Pennsylvania, 1969.

6. *Greenhouse Flower and Bedding Plants for Agribusiness Studies,* Williams, G. S., The Interstate Printers and Publishers, Danville, Illinois, 1975.

7. *Landscaping the Home and School Grounds,* South Carolina State Department of Vocational Education, Vocational Education Media Center, Clemson University, Clemson, South Carolina, 1970.

8. *Nursery Crops and Landscape Design,* Williams, G. S., The Interstate Printers and Publishers, Danville, Illinois, 1975.

9. *Plant Propagation – Principles and Practices,* 3rd edition, Hartmann, Hudson T. and Dale E. Kester, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1975.

***10. *Tips on Growing Bedding Plants,* The Ohio State University Cooperative Extension Service, Columbus, Ohio, November, 1975.

*Not essential, but a very nice publication – done in color.

**Not essential, but very comprehensive yet inexpensive.

***You may wish to order a supply of these for the entire class.